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ABSTRACT

In 1970, Worcester Polytechnic Institute (WPI) radically revised its curriculum by replacing specific course distributions with a new program, emphasizing projects at various levels. In instituting this change, faculty were especially concerned to encourage engineering, science, and management students to recognize how their professional work affects society at large. Thus the faculty adopted a unique degree requirement, the Interactive Qualifying Project (IQP). The IQP challenges students to define, investigate, and report on a topic of their choice relating science and/or technology to some social need or issue. This document describes the London Project Center at WPI; proceedings from a national science, technology and society competition; abstracts from 368 IQPs; and gives information on how to obtain the papers. In addition to providing abstracts for IQPs finished in 1986-87, this document also features award-winning projects and highlights activities in new project centers and programs. Also provided are abstracts of prize-winning student essays presented at a national competition held in conjunction with the international convention of the Society for the Social Studies of Science. (CW)

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UNDERGRADUATE PROJECTS LINKING SCIENCE, TECHNOLOGY AND SOCIETY

Abstracts of Projects Completed 1986-87
WORCESTER POLYTECHNIC INSTITUTE

London Project Center
1986-87 President's IQP Award-Winning Projects
Proceedings from the First National Student Projects Competition in STS

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UNDERGRADUATE PROJECTS LINKING SCIENCE, TECHNOLOGY AND SOCIETY

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Foreword

In 1970, WPI radically revised its curriculum by replacing specific course distributions with a new program, emphasizing Projects at various levels. In instituting this change, faculty were especially concerned to encourage engineering, science, and management students to recognize how their professional work affects society at large. Thus the faculty adopted a unique degree requirement, the Interactive Qualifying Project (IQP).

The IQP challenges students to define, investigate, and report on a topic of their choice relating science and/or technology to some social need or issue. The interaction between science, technology, and society is often delineated by using a method of study from the social sciences or humanities. Technology is defined broadly to include the management or critical evaluation of the efficient use of any resource. Every IQP must also have a significant technical component, and thus many faculty who advise IQPs are from engineering or science departments.

A decade after implementing the new program at WPI, the IQP remains a distinctive part of the undergraduate education of all students. It is not a course requirement or an honors program; every student must formulate and carry out a creative IQP topic equivalent in commitment to at least three conventional courses. Many projects involve off-campus sponsorship, through which alumni/ae often report encountering a sense of real-world problems they would otherwise have learned little about as undergraduates. By 1987, nearly one-half of all living WPI alumni/ae have completed IQPs.

In addition to providing abstracts for IQPs finished in 1986-87, Interactions 8 also features award-winning projects and highlights activities in new project centers and programs. In addition to surveying interdisciplinary programs at WPI, the eighth edition of Interactions provides abstracts of prize-winning student essays presented at a national competition held in conjunction with the international convention of the Society for the Social Studies of Science.

The Eleven IQP Divisions

Reviews of IQP activity demonstrated that several interdisciplinary themes repeatedly attracted student and faculty interest. These themes are recognized and supported through appropriate divisions like "Technology and Health Care" and "Risk Analysis and Liability." Other divisions like "Social Studies of Science and Technology" and "Science and Technology: Policy and Management" reflect the growing involvement of social science and management faculty in doing IQPs, many of which are close to their professional interests. The eleven current divisions are listed below, along with the faculty coordinators. Readers seeking more information on the work of any of these divisions should contact the coordinators at their WPI departments.

Division Numbers	Title	Faculty Coordinators
41	Technology and Environment	J. O'Shaughnessy (CE), R. D. Cheetham (BB)
42	Energy and Resources	D.W. Woods (SS), E.N. Clarke (DIA)
43	Health Care and Technology	R.A. Peura (BE), J. T. O'Connor (SS)
44	Regional Studies and Planning	F.L. Hart (CE)
45	Science and Technology: Policy and Management	S.V. Gerstenfeld (DIA)
46	Social Studies of Science and Technology	J.M. Wilkes (SS)
47	Risk Analysis and Liability	F.R. Tuler (ME), F. Noonan (MG)
48	Humanistic Studies of Technology	J.F. Zeugner (HU), S. J. Weininger (CH)
49	Economic Growth, Stability and Development	L.S. Graubard (MG)
50	Social and Human Services	L. Schachterle (DIA), J. van Alstyne (DIA)
51	Educational Theory and Curricular Development	T. Keil (PH), M. Humi (MA), L. Goodwin (SS)

The London Project Center

In March 1987, twelve WPI students under the direction of Professor John Zeugner (Paris Fletcher Professor of the Humanities at WPI) and Professor Maria Watkins launched the WPI London Project Center. Professor Zeugner's essay printed in this issue describes how a dozen undergraduates from WPI undertook what British college students rarely if ever attempt--to carry out professional quality projects with prominent government or institutional sponsors, complete with a final formal written report, in the short space of seven weeks.

As Professor Zeugner's essay emphasizes, the four projects were completed to the satisfaction, indeed relish, of all concerned in part because the four sponsoring agencies took their own responsibilities in guiding the students very seriously, and opened their staffs and resources to our students with uncommon courtesy and generosity. The dozen undergraduates lived, commuted and worked with British professionals to an extent rarely encountered in most "exchange" programs where students have very few opportunities to experience the foreign culture as full equals.

Following Professor Zeugner's essay are Executive Summaries of three of the four reports: "Electrical Engineering Manpower Projections for the UK" (Sponsor: Professor R. D. Langman, Cambridge University and the Electricity Council); "The Albert Henry Midgley Collection" (Sponsor: E. Symons, Archivist, The Institution of Electrical Engineers); and "Restructuring the Worshipful Company of Scientific Instrument Makers' Annual Achievement Award" (Sponsor: Major-General Younson, Worshipful

Company of Scientific Instrument Makers). The fourth report, "Evaluation of the Results of the European Patent Office and United Kingdom Patent Office Searches from the Users' Point of View" (Sponsor: G. Lindsey, UKPO) was one of two winners of the autumn 1987 President's IQP Awards Competition, and this Executive Summary is printed with the other prize winner.

WPI and especially the project program are indebted to Professors Watkins and Zeugner and the twelve students who inaugurated the London Project Center with such energy and excellence. We look forward with eager anticipation to the second group of projects which, in addition to topics undertaken again with the Patent Office and the Institution of Electrical Engineers, will include research conducted with the Royal Society, the London Docklands Authority, and Ferranti Electronics.
[ProfessorZeugner returned to London in April, 1988 to lead off the IEE Discussion meeting on "Manpower Requirements for Electrical and Electronic Engineers in the UK Until the Year 2000" by presenting the work of the WPI student team at the IEE.]

WPI Hosts Two Major Interdisciplinary Conferences

The Society for Literature and Science

Autumn 1987 was unusually busy for those faculty at WPI engaged in interdisciplinary research, as the college served as institutional sponsor for two major international conferences.

In October, the new Society for Literature and Science held its first conference at the Worcester Marriott and WPI. The distinguished author and lecturer Stephen Jay Gould opened the meeting with a public address on the theme of the symposium, "Literature and Science as Modes of Expression." Gould skillfully examined how creating systems of names to categorize phenomena is a necessity for science but also a problem when systematic categories erect unhelpful barriers between related activities, like the seeking of truth in science and in the arts.

The conference continued with over seventy formal presentations, and major addresses by Gillian Beer (Cambridge) and G. S. Rousseau (UCLA). Over one hundred and fifty members attended, from almost forty states and eight different countries. At the business meeting, Professor Stephen J. Weininger (WPI Chemistry Department) succeeded the founding president, Lance Schachterle.

Professor Weininger announced that the well-known series, Boston Studies in the Philosophy of Science, has agreed to publish selected proceedings from the conference. For readers of Interactions 8 interested in more information about SLS, including the Proceedings or the already-published Abstracts, contact either Weininger or Schachterle at WPI.

The Society for the Social Studies of Science

Just a month after the SLS conference, WPI and the Marriott hosted another international event, the annual conference of the Society for the Social Studies of Science (4S). Professor John Wilkes (WPI Social Science and Policy Studies) served as the local coordinator for three inter-related events: a two-day series of presentations and discussions on Science, Technology and Society (STS) programs in the US, England, Holland, and

Australia; the 4S professional convention itself, and a final overlapping two-day series of presentations from students around the country who had been invited to read papers on their own STS projects.

At the STS program presentation, a delegation from WPI, chaired by Professor William R. Grogan, Dean of Undergraduate Studies and an architect of the WPI Plan, discussed in detail how the Plan originated and continues as one form of STS education. Professor Douglas Woods (head of the WPI Social Science and Policy Studies Department) examined the WPI Plan and the IQP from his perspective; his essay, entitled "The Role of the Social Sciences in the Interactive Qualifying Project," is included in this issue.

Professor Wilkes reported on a number of his research projects (many of which grow in and out of his IQP advising) at the 4S professional presentations. Finally, at the student conference, no less than ten WPI teams made presentations of their IQPs in the presence of members of the WPI and national Student Pugwash organization and other undergraduates in the STS competition from Yale, Wesleyan, the University of Michigan, Duke and elsewhere. Interactions 8 is pleased to offer executive summaries of these prize-winning essays, as edited by Lance Schachterle.

The Autumn 1987 President's IQP Awards

WPI sponsored two student awards competitions for IQPs in 1987, in order to carry out a transition from a spring to an autumn competition. On February 25, four judges awarded three prizes after hearing an afternoon of presentations at the WPI Higgins House. The winners in this event were:

Robert P. McGuirk and John Phelps, "Product Liability in the Pharmaceutical Industry: The Case of Bendectin" (advisor: Professor Helen Vassallo),

Mark Hansen, Thomas Bogaczyk, and Nicholas Werthesses, "Cable Television-Based Remote Metering in Shrewsbury" (advisors: Professors James Demetry and Gordon Branche), and

Chrys Demetry, Holly Daley and Paul Kutchukian, "Career Guidance in Engineering" (advisors: Professors Stephen Weininger and Kenneth Ruscio).

Judges for this competition were Jon C. Strauss, President of WPI; Dean Richard H. Gallagher, Provost and Academic Vice President of WPI; Professor Lionel Friedman, newly-appointed professor in electrical engineering; and Professor John Anderson, History Department, College of the Holy Cross, and Mayor of Worcester, 1986.

In the autumn, in conjunction with the international convention of the Society for the Social Studies of Science (4S), WPI held the second 1987 President's competition for the best IQPs completed in the previous twelve months. This competition was scheduled as part of the 4S conference, giving our students the opportunity to participate as presenters in an international professional convention. The winners were:

Sergio Levi, Robert Petrin, and Andrew Scholand, "Evaluation of the Results of the European Patent Office and United Kingdom Patent Office Searches from the Users' Point of View" (advisor: Prof. John Zeugner), and

Tusha S. Hoskere, Carolyn F. Mahoney, Valerie J. Tanigawa, and Maureen A. Theis, "Abortion Policy: A Collision Course" (advisor: Prof. Kenneth Ruscio).

Judges for the competition were Jon C. Strauss, President of WPI; David Edge, President of the Society for the Social Studies of Science; Ben Lev, newly-appointed head of the WPI Management department; Martha

Crunkleton, Director of Special Programs at the College of the Holy Cross, and James Dempsey, columnist with the Worcester Evening Gazette. Abstracts of the two prize-winning reports are contained in this issue.

WPI Studies in Science, Technology and Culture

The new WPI publication series, "WPI Studies in Science, Technology, and Culture," is pleased to announce that four books have been accepted for publication. The topics include a study of Russian scientists who immigrated to Israel, an examination of the philosophy of technology from the point of view of esthetics, a comparison of risk analysis of off-shore oil drilling in the United States and Europe, and essays on the social impact of man-made technological disasters (like the Chernobyl nuclear mishap). Several other titles are under discussion, and the series editors would be pleased to hear from any potential authors about proposed new volumes. The series is published by the international firm, Peter Lang Publishing, New York. Interested authors should contact Lance Schachterle, The Projects Center, WPI, 100 Institute Road, Worcester, MA, 01609 (617 793-5514).

The 1988 Hull Lecture

The 1988 Hull Lecture will be delivered by Dr. Christopher T. Hill, Senior Specialist in Science and Technology Policy at the Congressional Research Service, Library of Congress. Dr. Hill's topic will be "Technology Policy for the 1990s," focussing on how America can better mobilize our private and public resources to improve our productivity in the face of foreign technology-based competition. The lecture is free and open to the public, and will be held at WPI's Kinnicutt Hall on Tuesday, April 26, at 4:30 p.m.

Solar Cars in Australia

[The following report is from Professor Ed Clarke, Director of WPI's Center for Solar Electrification. Professor Clarke contributed an essay on his solar ventures (and adventures) to last year's Interactions. He would be delighted to hear from readers who share his interest in solar PV science and technology.]

During the early part of November, 1987, I was privileged to participate in the World Solar Challenge, the world's first transcontinental solar car race, as the only educator invited by General Motors Corporation. The race tested the vision that vehicles can move continuously in sunlight with no other source of fuel or energy but that of the sun itself. The event was a grueling run from Darwin to Adelaide, a distance of 2000 miles through the OUTBACK of Australia. Twenty-four solar cars from all over the world participated and the race was won by the General Motors GM SUNRAYCER. The SUNRAYCER averaged 42 miles per hour completing the course in just over five days, besting the second place Ford (Australia) car by two days. The Swiss car from the engineering college at Biel, Switzerland, finished third, just behind Ford, and represented the best of the engineering college entries. The "Spirit of Biel" was aided

and supported by Mercedes Benz. The three Japanese cars performed rather poorly, and in the race were beaten not only by the leaders but also by a number of fine entries from Australia, Denmark and M.I.T.

The race organizer, Hans Tholstrup from Denmark, became an Australian citizen about ten years ago. He is a modern adventurer. It is now recognized that his efforts have done more to enhance the public awareness of solar photovoltaics as a source of electricity (the cars were powered by electric motors) than any other single event in the thirty-year history of solar PV. The response by GM was to create a solar car using the most advanced technology in all elements of vehicle design and to create what is surely a major contribution to mankind.

Hans Tholstrup compared GM's achievement to man's first flight. "It's simply as important as that. Also, GM has done for energy efficiency what Kennedy did for the space program. It's a little awesome."

Cover Photograph

The photograph on the cover, taken by WPI's Director of Publications, Ken McDonnell, juxtaposes images of London's past and present. Tower Bridge, close to the ancient heart of London, "The City," frames the construction equipment reshaping London into new commercial and residential zones. In 1988, WPI is undertaking its first IQP with the London Docklands Corporation, which is overseeing in London the largest urban renewal project underway in Europe.

Obtaining Copies of IQPs

Copies of all completed IQPs are submitted to the WPI Gordon Library, and may be viewed by request at the Reference Desk. Hard copies of reports are also available by mail upon request at cost (xeroxing, shipping, and handling). A request form to order reports appears as the last page of this publication. Faculty advising projects requested by off-campus readers are automatically notified of that request.

WPI first published INTERACTIONS in 1978. That issue contained essays on development of the IQP generally and on specific topical areas. Every year since then, WPI has published the abstracts of a previous year's collection of IQP work. INTERACTIONS is sent free of charge to any person or agency requesting it. Readers are encouraged to propose IQP topics to WPI, to use abstracts in the classroom as examples of undergraduate research projects, or to communicate with this office about establishing interactive project programs at other campuses.

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First IQPs at the New WPI London Project Center

by Professor John Zeugner

The formal opening of the WPI London Project Center in the spring of 1987 coalesced very divergent lines of academic and personal interactions. In the early 1970's, as part of a wholesale revision of the WPI curriculum, the college adopted a requirement that all students must complete an Interactive Qualifying Project (or IQP) relating science or technology to society. Transplanting the IQP program established in the 70's to London in the 80's would have been quite unthinkable without the substantial experience of project center activity in Washington, D.C. Twelve years of working with government, institutional and private agencies in that capital provided the assurance that intense on-site efforts relating technology to society could be undertaken successfully by undergraduates. Indeed, the Washington projects have succeeded in claiming at least one Presidential IQP award annually since the inception of the prize in the early 1970's.

I.

The pioneer work of the WPI Washington Project Center director, Dean Francis Lutz, established that undergraduates could produce meaningful, professional reports in seven weeks time of full-time work off-campus. Lutz fashioned a rigorous preparation course before the on-site experience and then devised a tight schedule of project accomplishment. At the same time, the inherently open nature of projects preserved student freedom of interpretation even as it made completion of work inevitable. The Washington manuals for the project work would become the model of the London effort although the endproduct along the Thames ultimately would not look quite like its counterpart on the Potomac.

Agencies in the American capital were accustomed to having undergraduates around as interns or co-op workers, but were quite unused to the final project reports that WPI students produced in the seven week term. Further, those final reports often enough achieved a professional quality rivaling the work of outside paid consultants. As the Washington Project Center developed, the fee WPI eventually charged participating agencies looked more and more like a remarkable bargain.

But D.C. supplied more than historical assurance for the London venture. Discussions by members of the American Patent Office with their British counterparts in London led to a proposal by the United Kingdom Patent Office (UKPO) for one of the first projects in the London Project Center. Personal contacts were also crucial in developing the London center. In particular, the decade-old cooperation in undergraduate exchange programs between Professor Lance Schachterle from WPI and Professor Maria Watkins from The City University was invaluable.

In London, Professor Watkins shepherded American undergraduates through a semester or two at The City University and Schachterle looked after the British counterparts at WPI. As their cooperation deepened, they recognized that the Washington Project Center had come to such fruition that exporting and capitalizing on the learning curve there seemed logical,

inevitable. The notion of Project Centers, whether for municipal concerns in Central Massachusetts or for medical issues in San Francisco or for international government/business/institution interactions in London had definitely arrived. All that remained were the tough barriers of making the contacts, finding student residencies, recruiting faculty advisors, and screening student applicants for the experience across the seas.

Fortunately, WPI quickly recognized that Maria Watkins' professional contacts, coupled with her extensive experience as a residency advisor for students and an acute sense of housing availability, made her the best possible choice as "anchor" for the British side of the London Project Center. By the fall of 1986 the students for LPC 1 had been selected, Watkins had been designated the Resident Director of the effort, four British agencies had agreed to host projects, and a faculty resident advisor from WPI had been named, Professor John Zeugner.

II.

Zeugner had been a resident faculty advisor in Washington in the fall of 1980 and he imagined the London experience would shadow at least the outlines of the D.C. situation. That had been his premise in "revising" the D.C. manual in anticipation of the U.K. adventure. Zeugner also had extensive experience in international education, having taught at several Japanese universities.

The preparation course under Professor Sue Vernon- Gerstenfeld's skilled direction took the students through social science modeling, interviewing techniques, small group dynamics and the initial apparent requirements of the particular projects from the proposals prepared by the agencies. Zeugner knew the London students were an interesting group when the team assigned to the Workshipful Company of Scientific Instrument Makers showed up in T Shirts with "WCSIM -- We Do It With Precision," emblazoned on the front.

He also believed the preparatory course could only generically get students ready for projects that might have shifted focus even as the initial 12 undergraduates crossed the Atlantic. That often enough had been the D.C. experience. Zeugner remembered turning up in that Congressman's office in the fall of 1980 only to be told, "We thought you guys were coming after Christmas and what was your project about anyway?" But the London experience was to be far different.

In the first place the British seemed to take the project assignment far more earnestly than had some D.C. agencies. The liaisons for the projects, Professor David Langman (Cambridge University) at the Electricity Council and the Institution of Electrical Engineers (IEE), Mr. Peter Back at the U.K. Patent Office, Major-General Eric Younson at the Worshipful Company of Scientific Instrument Makers, and Mrs. Elizabeth Symons at the Archives Department of the IEE, had very clear ideas what the project should be and more importantly how the project should be used within their agency. More remarkable still, each of the liaisons was backed by an outside committee (sometimes two outside committees) that had clear knowledge of the project and a clear concern for monitoring the students progress. With Watkins, Zeugner, the liaisons and the back-up committees watching, the London projects would not lack for supervision.

The London agencies, in addition, wanted very much to use the results of the students' work; as with most WPI off-campus collaborations, the agencies invested their resources because they valued the student

findings. The Patent Office wanted the student team to reassess the validity of an outside consultant's report advocating certain changes in the office's search process to make the agency more competitive with the European Patent Office at the Hague. The issue was hardly academic since competitiveness would be crucial as the Thatcher government considered "hiving off" or privatizing the U.K. Patent Office.

Professor Langman believed a careful projection of trends extracted from data in the yearly IEE salary survey would reveal not only an emerging manpower crisis in Britain's power-generation capacity, but also serve as a model for future extrapolations from the rich IEE salary data.

The Worshipful Company of Scientific Instrument Makers wanted to expand and professionalize the means of finding and assessing potential candidates for its annual award for technological innovation. The Company--a modern-day guild for makers of high-quality mechanical and electronic instuments--wanted to publicize its award and increase its stature in the industrial community. Thus the Company continues to make an important contribution to British industry by recognizing excellence in technological innovation.

The Archives Department of the IEE needed to demonstrate that the IEE should indeed be in the history business by developing access to the archives material and by creating documents discussing and evaluating the IEE holdings. In particular, the department wanted help on sorting and evaluating the enormous holdings (in no less than eighty boxes and chests) of the twentieth-century inventor, Albert Henry Midgley.

London agencies had clearly indicated they would take the efforts of undergraduate proto-professionals with seriousness. Perhaps the novelty of the concept set the agencies planning carefully for the first class of students. No British university--or American, for that matter, save WPI--sends its students into the non-academic world with the imperative of first working on and then writing about the interactions of technology and society. Thus the British agencies, sensing the novelty of the kind of contribution the IQP offered, worked closely in the preparation phase of LPC 1 to insure that students would arrive in London well prepared to get on with their business.

Agency needs were only a portion of the experience however. There were other components. The American students were trained in a vocabulary and a set of heuristic methods that were naturally enough culture bound. Vocabulary itself reflected certain blinders, as the Archive students discovered when they learned that "valve" in Britain in the Midgley papers was equivalent in America to "vacuum tube." More importantly (since after all, the students and their agencies did speak the same language), the Americans were steeped in the peculiar time-sense of Worcester Polytechnic Institute. A time sense that yielded a work-sense with heavy emphasis on application and instantaneous mastery, a kind of controlled frenzy that in its glorious moments might crank out stunning reports and heated insights, and in its less glorious times might only be noisy wheel spinning.
But in London the Easter vacation means for many Londoners more time off than just Good Friday and Easter Monday. It is a serious vacation period. So data centers, interview possibilities, facilitating agencies tend to close down. Key personnel may be unavailable. Adjustments have to be made; new rhythms of accommodation sought.

In making accommodations the initial twelve undergraduates began the slide down the well known U curve described in the literature of cross-cultural experience--that steep descent from high expectations to

desperate despair and then an ascent to some lesser point of compromise that allows the outsider to survive and partially flourish in the other culture. The project teams were not tourists in London, but true residents living and working the city as did millions of British. The U curve applied as well for eight week resident/ workers as it did for longer term visits.

Fortunately undergraduates are nothing if not resilient. The several cultural shocks of London life were only brief setbacks: baths rather than showers; grocery stores that closed early and check out systems and apartment refrigerators that assumed everyday shopping rather than once-a-week American binges; telephones that perhaps five or ten percent of the time didn't respond, but were leagues ahead of the U.S. in the use of cash cards; reticent patrons of the pubs and discos who assumed you had friends (rather than wanted to make them); codes of public silence to balance absolute license of public dress. The list of surprises was endless--from the steep elevator runs to tube stations deep beneath the earth to those too stout (and stout filled) pub glasses that fingers could just barely reach around.

While on the slide down the front part of the U, the project teams nonetheless began the frenetic struggle to make the projects their own, to function effectively within the vice of agency needs and WPI deadlines, to live within the dual crunch of American conditioning and British assumptions.

In the process mesmerizing to watch, each team moved through the exigencies of the agencies to fashion projects appropriate to college requirements and London realities. The UKPO group (Sergio Levi, Robert Petrin, and Andrew Scholand) scrapped their original methodology, went off to the Hague for a personal survey and decided in-depth interviews with British patent agents might yield new conclusions--which, indeed such interviews did. The final report impressed the Patent Office, won the President's Award at WPI, and diverged strikingly in its recommendations from the prior outside consultant's survey.

The IEE salary survey team (Karen Desrosiers, John Powers, and Mark Wartski) quickly understood that a grasp of multiple regression analysis, futurology, and the intricate details of the British educational regimen, was the key to project autonomy. By the time of their final presentation to the M-2 Committee of the Electricity Council, their liaison Professor Langman decided the team should return to London in the spring of 1987 for a presentation to an invited audience of government and business leaders.

At the Worshipful Company of Scientific Instrument Makers, the team (Paul Mancini, Jodi Medeiros, and William Noel) ingeniously devised myriad new ways of finding applicants for the annual award, created a new application form, found new avenues of publicity, and then voyaged out from London to review several potential winnners at their sites, culminating in a recommendation to the company. (And the Company subsequently gave its 1987 award to the organization recommended by the WPI student team.)

The IEE Archives students (David Burrage, Henry Clark, and Michelle Pence) displaying awesome energy and tenacity simply itemized the eighty boxes of the Albert H.Midgley holdings and created the computer program to make the boxes instantly accessible. Having created the underpinings for serious research, the team then wrote a biography of Midgley, whose life as a British inventor/entrepreneur spanned eighty years, by utilizing oral interviews with members of the Midgley family, as well as extensive research in modern British social and economic history.

The dizzying interaction of agency needs, WPI IQP requirements, student initiatives and London culture shocks provided a unique learning experience. Mind-widening in ways no conventional undergraduate program can be. The Patent Office team not only had to master an entirely new vocabulary and arcane art, but had to deal with the political game structuring that art internally and externally at the premises. The manpower team needed to master the brand new-to-them tool of multiple regression analysis. Fortunately at a crucial moment in the project, Professor Watkins steered Mr. James Boggis, retired from the Electricity Council, to the team and he displayed that rarest of gifts, the ability to make econometrics quickly intelligible and useful. Moreover, the Manpower group had to fathom the complex, baroquely layered approach to public education in the U.K. and at the same time discover and utilize predictive models for manpower projections. The Worshipful Company group needed to understand the nature of innovation in technology and then apply that understanding to a different culture's industrial creative process--all in seven weeks! And finally the Midgley team had to discover ways of integrating social movements, economic structures with the particularities of one unique life, to describe the networks linking a person to social environment over a long peiod of time.

All this inquiry went on beneath London's leaden sky that save for a glorious three week splurge of sunlight around Easter soaked and sagged and dripped as if lined with saturated cotten batting.

Everything about the city suggests heftiness--the food, the architecture,and the life in London are weighty. The rhythms of the place are deeply inimical to tight or arbitrary project deadlines. London's density and diversity quickly slides over and muffles the intentions of outsiders. London's climate dissolves brashness; her civilized decorum can undermine all overweening ambition. The payoff for the required assimilation is of course that London remains the intellectual-cultural center of the English speaking world. For English has become the common language of most of Asia, all of North America, vast segments of Africa and the European periphery.

The mere listing of events in London makes a publication each week about half the thickness of the Worcester (USA) telphone directory. For concerts, movies, nightclubs, pubs, discos, lectures, forums, discussion groups, theatres, ballets, and galleries there is no place like London on the rest of the planet. Currently, in ways British politicians lament, London has become a super magnet drawing the talent, brains, and energies of the rest of the British Isles to it. The traditional North/South problem of Britain may eventually reduce to a London/elsewhere problem, but that, for outsiders at least, only makes the London experience richer and more enthralling.

III.

To commemorate the inauguration of its newest off-campus project center, WPI sponsored a formal banquet for the LPC 1 participants in the main assembly room of Glaziers Hall on April 13, 1987. At that evening dinner The Baroness Platt of Writtle C.B.E. gave the inaugural address, a review of Worcester Polytechnic Institute's aspriations for the Interactive Qualifying Project and a challenge to both British and American culture to extend engineering education to more women. The audience included representatives from British agencies sponsoring projects, WPI alumni in

the U.K., and Deans William R. Grogan and Francis Lutz as well as Professors Schachterle, Watkins, Zeugner, and the twelve students of the first year of the center. As a special tribute to future WPI students who would benefit from the pioneering energies of the initial participants in the LPC, two first-year students, Jeff Yoder and Nancy McLaughlin, attended to present the greetings of their class. The banquet began and ended in the River Room of Glaziers Hall overlooking the Thames, a stream whose depth and surge had ably accommodated Celts and Romans and Normans and that now seemed congenial enough to the enormous promise, and slight disturbance of, American Interactive Qualifying Project students.

In their responses to Baroness Platt's presentation, Dean Grogan stressed that the London Project Center had again proved the validity of the cornerstone of WPI's undergraduate education program: that students, well prepared and advised, could through projects produce professional reports of exceptional sophistication and depth. Dean Lutz thanked the agency liaisons for their extraordinary commitment and support in the new venture. Professor Schachterle thanked Baroness Platt for her kind words about WPI's project program, and echoed her call for enhanced support for women interested in careers in modern technology. (Evidence of WPI's own commitment to this theme may be found in what the college hopes will be a series of LPC projects beginning this year that compare the efforts of British and American higher education to make engineering more accessible to women as a profession.)

Compared to the city's diversity and density the interactions of twelve American students and their host British agencies must seem a glancing experience, but on a personal level such was far from the case. At the final presentations of the projects liaisons and committees expressed an extraordinarily warm appreciation for the accomplishments of the first teams of LPC 1. The chair of the IEE Archives Advisory Committee, Dr. Arnold Lynch, gave each member of the student team a British crown coin as a commemoration of the first year, and bid them remember London kindly.

Executive Summaries of London Projects, 1987

"The Albert Henry Midgley Collection"

by

David A. Burrage
Henry J. Clarke, III
Michelle A. Pence

Albert Henry Midgley (1881-1961) was a British electrical engineer who invented or improved many devices. He also kept exhaustive records of his many inventions. A portion of Midgley's records was donated to the Archives Department of the Institution of Electrical Engineers in London.

The Midgley Collection project consisted of three objectives. The first objective was to prepare a detailed list of the entire contents of the Collection. The second was to design a computerized cataloguing system to make specific documents in the Collection easy to locate. The third objective was to write a preliminary analytical biography of Albert Midgley, placing him in context of his contemporary British history.

To accomplish the first objective, the project team read through the entire collection and created a detailed list of the contents that was both easy to read and informative. The information included the box number, folder title, date, and type of document.

The project team met the second goal using the software package CARDBOX PLUS, already in use at the IEE. CARDBOX is a package which simulates index cards, each of which has the information or a document or a group of documents. A document can be found by selecting the desired topic or date, and the program will then list all of the cards which contain that type of information. The project team chose the fields, or categories, from the list of the collection. The team then arranged the fields on the computer screen for ease of viewing and comprehension.

The project team accomplished the third objective by researching British social, economic, and industrial history to provide context for Albert Midgley's life. The team also conducted interviews with family members for biographical information, and with experts in the fields of Midgley's inventions. A biography of Albert Henry Midgley, written by his eldest son, Albert Morrell Midgley, was the single largest source of information on Midgley. Therefore, to produce one useful document, the project team incorporated this document into the new text, expanding on certain subjects and filling in gaps. Particular expanded sections include Midgley's early years, historical context during the 1920's and 1930's, his work during World War II, and the post-war era.

The project team also identified three questions that merited further research. The first surveyed the career patterns of electrical engineers to discover if Midgley fit these patterns. The project team conducted this investigation by gathering 109 obituaries of electrical engineers born around the same time as Midgley from the Journal of IEE. This research was also conducted with the Dictionary of Business Biographies, with the entries examined for topics such as type of schooling and the engineers' careers. The result of this study determined that

Albert Midgley's career was similar to those of the more successful inventors. However, the explanation for why he was not as successful requires more research. The second question investigated Midgley's creativity in an attept to determine the nature of Midgley's inventive talent. Using information obtained from the Collection and from interviews, the project team determined that Midgley's talent was mainly the ability to adapt or improve existing designs, though he also created unique designs of his own. Finally, the project team investigated the issue of the profitability of Midgley's inventions. The team researched patent renewals and used information from both the Collection and interviews in an effort to determine which of Midgley's inventions were profitable and why. The results of this investigation were inconclusive and merit further research.

From the work done with the Midgley Collection, the project team had several recommendations. First, due to limited storage space, all published materials in the collection should be discarded, as they can be found elsewhere. Also, John Midgley (Albert Midgley's grandson) should be consulted because he possesses additional records which may be better housed at the IEE. The project team recommends that the ICL computers currently used at the IEE should be replaced by the faster and more versatile IBM-compatible computers, and a printer should be purchased for the Archives Department. This replacement would also allow the use of DBASE III or CONDOR 3, software packages which offer superior cataloguing capabilities, but are not compatible with ICL computers. Finally, the project team recommends that additional project groups or graduate students continue to research the areas that were identified but only briefly investigated in this project.

"Electrical Engineering Manpower Projections"

by

Karen Desrosiers
John Powers
Mark Wartski

There were two primary objectives of this project. The first was to formulate manpower projections of electronic and power engineers to the year 2000 by utilizing the Institution of Electrical Engineers annual salary surveys. The second objective was to make recommendations to the IEE concerning the ongoing use of the survey as a projection instrument and on further issues concerning electrical engineering manpower supply and the educational sector of the United Kingdom.

The methodology utilized to accomplish these objectives first focused on the educational system. Because the education sector is the primary source of engineers, future trends of the tertiary educational sector had to be examined. The second focus of the methodology concerned the utilization of the IEE salary surveys as the database for electrical engineering projections. The raw data of the numbers of electronic and

power engineers was extracted from the surveys over the ten year period from 1976 to 1986. Utilizing two indices, the Gross Domestic Product (GDP) and time, in conjunction with the adjusted number of electronic and power engineers, simple and multiple regression analysis were performed. Projections to the year 2000 were then attained by performing linear and logarithmic extrapolations.

The third focus of the methodology incorporated external problems that could possibly affect the linear extrapolated projections. The effects of the educational sector on the projection and any internal industrial problems were then examined.

The analysis and results focused primarily on manpower forecasts. Projections to the year 2000 of electronic and power engineers were performed with multiple regression analysis, utilizing explanatory indices, GDP and time.

Age cohorts were examined in both electronic and power engineers to note if any shifts within the respective fields were occurring. Electronic engineers of the IEE have remained predominately in the 25-39 age category; however, detrimental age shifts were observed in the power engineering field. In one decade, the age groups of power engineers have shifted from ages 25-54 to ages 40-59, and if these age shifts continue the power industry will experience a drastic shortage of power engineers in the near future. To magnify the power engineering problem, the number of technical staff and trainees in the power industry has decreased dramatically since 1966.

Recommendations were made to the IEE. The following were the primary suggestions:

1). The further implementation of an industrial and educational collaboration plan would aid in improving the skill and supply of electrical engineering graduates.

2). The establishment of a night time education program, similar to the U.S. system, would help to lessen any possible electrical engineering shortage.

3). The annual repetition of electrical engineering manpower projection would allow the UK to act immediately to avoid any future manpower problems.

"Restructuring the Worshipful Company of Scientific Instrument Makers Annual Achievement Award"

by

Paul Mancini
Jodi-Ann Medeiros
William Noel

The primary purpose of this project was to develop an award methodology which could be used by the Worshipful Company of Scientific Instrument Makers to gather potential award winners and to obtain the

required information about them. A number of smaller tasks were also completed including gathering and evaluating applicants for the 1987 Achievement Award and devising ways to improve the overall quality and prestige of the Award.

The development of the award methodology was divided into two parts. The first concerned organizing and streamlining the application process. Several applications for awards similar to the Achievement Award were studied to determine the best method of gathering information on the products. An application form was developed that incorporated the best features of all the awards that were studied.

The second part of the methodology centered around developing sources that could be used in the future to find potential applicants for the Award; The Worshipful Company of Scientific Instrument Makers has a limited amount of time and money available to spend on the Achievement Award, therefore these sources needed to provide the most information on developments in the instrumentation industry with the least expenditure of time and money. Many sources were studied, including periodicals, trade publications, university research groups, trade shows, and patent office material. However, only the most efficient sources were selected for use on a continuous basis.

This project has several results, the first of which is the application developed by the project team. The application can be mailed to prospective award winners and when returned, will contain all of the information needed by the livery company. Another result is a list of different sources to consult when searching for new instrumentation products suitable for the award. Two different lists were formed. One contains companies that are well known and have a history of successful products. These companies can be contacted periodically to see if they have any new products worthy of consideration for the Award. The second list contains sources from which new instrumentation products can be obtained directly. These sources include specific periodicals, computer data bases, patent specifications, and trade shows. Each source has been carefully chosen to consistently provide the most current information with the least amount of time and money required.

Other results stemmed from the development of the award methodology. Additional applicants for the 1987 Award were gathered. Visits to manufacturers were made to review the most promising applicants and a preliminary recommendation was made to the livery for the 1987 winner. Finally, a list of general recommendations outlining ways in which the general quality of the Award can be improved was formulated.

The project team recommends that the livery adopt the methodology developed in this project on a trial basis for a period of two years. During this period, the livery should review the sources established by this project to construct a list of innovative products that may be appropriate award winners. The application developed as part of the project can be sent to the manufacturers to obtain the necessary information on each product. After reviewing the applications, four or five finalists should be chosen. Members of the livery should then visit the manufacturer of each product to see the instruments in operation and to ask any further questions. Once the visits are completed, the award winner should be chosen by the Education Committee, the group within the livery responsible for the Achievement Award. This recommendation is preliminary, pending the addition of new applicants.

1986-87 President's IQP Award-Winning Projects

"Evaluation of the Results of the European Patent Office and United Kingdom Patent Office Search from the Users' Point of View"

(conducted at the London Project Center, 1987)

by

Sergio Levi
Robert Petrin
Andrew Scholand

Advisor: Professor John Zeugner

The patent system is important to the spread of technological ideas into society, promoting innovation by granting members of the inventing public limited monopoly rights on new ideas and processes. The patent system is created and defined by legislation, and the patent office can only implement this legislation.

The patent search, an integral part of the patenting system, must strike a balanced compromise between the conflicting demands of full protection and acceptable costs. The ideal search, a thorough world wide study of all prior patents and technical literature, would guarantee an incontestable patent but would also be extremely expensive.

The United Kingdom Patent Office (or UKPO) is particularly concerned that the search effectiveness/cost balance is satisfactory to its users because, in accordance with current government policies, it is soon to be converted from a governmental body to a private organization. Initial research conducted by a consulting company, P-E Services, uncovered unexpected strong user criticisms of the UKPO. This project was commissioned to study the validity of these criticisms, particularly as they related to the search process, and to ascertain if policy changes were called for.

To these ends, a series of in-depth, personal interviews with London patent lawyers was conducted to obtain users' opinions of the quality of search carried out by the UKPO. These interviews centered around an interview schedule that was the result of a concentrated on-site study of the UKPO's search techniques. The sample of patent lawyers was chosen to represent both the large and the medium sized corporate inventors, and also the individual inventors.

To parallel these efforts, investigations were initiated at the European Patent Office (or EPO) in Holland. EPO senior staff members helped to detail the dissimilarities between the two offices. In addition to these EPO sessions, another series of interviews was conducted with a smaller sample of Dutch patent lawyers. These interviews revealed pertinent information on the weaknesses of the EPO system and on the changing role of national patent offices.

The results of the London patent lawyer interviews were substantially different from the conclusions reached by the P-E Services report. The concensus of patent lawyers indicated a high degree of satisfaction with the value for money provided by the UKPO

search.

To be of use to the UKPO policymakers, then, the recommendations had to reflect the fundamental user satisfaction in the status quo, and remain feasible given a restricted agency budget and the rigid system of legislated patent rules. Thus, recommendations were made against obtaining additional technical material and foreign patents, based on the prohibitively high cost of such an operation. The Patent Office was urged, however, to increase its use of currently available non-British technical material in all patent searches. Finally, to answer the desire of a small sector of the inventing public for professional searches in specific topical areas, or "infringement" searches, suggestions were made to aggressively market the UKPO's new service of computerized searches.

Abortion Policy--A "Collision Course"?

by

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Advisor: Professor Kenneth P. Ruscio

This Interactive Qualifying Project is a medical study of the controversial issue, abortion. Our focus was primarily on the technological advances and their effect on the trimester/viability model, established in the 1973 Supreme Court decision, Roe v. Wade. This model divided pregnancy into three trimesters. The first trimester, the first 12 weeks of gestation or 14 weeks after the last menstrual period, was based upon the safety of abortions and the mother's right to privacy. In the second 12 weeks, the court allowed the state to intervene when the mother's health was in question. In the last trimester, the major factor was the viability of the fetus. The Supreme Court created this model by weighing many factors, including the interests of the mother, the fetus, and the state, as well as the available scientific and technological evidence.

We feel this project met the requirements of the IQP since it combined different disciplines such as Biomedical Engineering, medical and biological sciences, with the social issue of abortion. It illustrates that it is difficult to solve a social issue by means of technology alone.

To begin our study, we familiarized ourselves with relevant literature to gain a better understanding of this issue. We then proceeded to interview and site-visit Neonatal Intensive Care Units (NICU) and abortion clinics in four different states. These interviews provided the facts necessary to evaluate the validity of the model.

At the present time, we found that due to advances in medical technology, a fetus could survive outside the mother's womb earlier in

the pregnancy, and allowed for safer abortions later in the pregnancy. This created a "collision course" within the trimester/viability model. Theoretically this "collision course" is inevitable; however, from the information gathered, we concluded that, in practice, this "collision course" will not occur in the near future. This is based upon our findings that viability is stable at 24 weeks, which is the end of the second trimester.

Based upon this evidence we decided to re-examine the framework of the model. We proposed a bimester alternative to the trimester model. The proposed model provides a new approach in defining the government's role in the abortion issue. It does not, of course, eliminate the controversy surrounding abortion, but it does provide a basis for determining how government can establish policy in an area complicated by a multitude of social, ethical, moral, and technological considerations.

The Role of the Social Sciences in the Interactive Qualifying Project

by

Professor Douglas W. Woods, Head,
WPI Department of Social Science and Policy Studies

The goal of the Interactive Qualifying Project is to provide students with an opportunity to learn about the relationship between technology and society. "The IQP," according to the WPI Undergraduate Catalog, "aims to make students sensitive to general social problems, aware of the societal - humanistic - technological interactions, able to analyze these interactions and to make better judgments and policy recommendations."

In any study of the technology/society interface social science clearly has a central role. The importance of social science to the IQP is so obvious that in the original formulation of the WPI Plan it was assumed that students would be drawn into formal study of the social sciences as part of their preparation for the IQP. Consequently, students were not explicitly required to take social science courses. The requirement that a student take at least two courses in social science was only recently introduced as part of a general movement toward greater reliance on course requirements in the WPI educational program.

The role of social science in the Interactive Qualifying Project is reviewed below. Initially the emphasis is on that ninety percent of the IQP activity directed by non-social scientists. Social science faculty have been more heavily involved in advising IQP's than the faculty of any other department. But our small number has meant that only about ten percent of the projects completed each year are advised by social scientists.

Our discussion of the projects advised by non-social scientists focuses on the IQP's advised by engineering and science faculty as opposed to humanities faculty. We did not attempt to appraise IQP's where the linkage between technology and society is provided by disciplines other than the social sciences, as in projects advised by humanities faculty.

We conclude that the IQP's advised by scientists and engineers do appear to be meeting the fundamental objective of the IQP. They make students aware of the importance of society/technology interactions. However, the failure of most of these projects to make fully effective use of appropriate social science concepts and methodology has prevented these projects from fully achieving the aims of the IQP.

Many of the Interactive Qualifying Projects advised by the engineering and science faculty at WPI tend to be similar to the kinds of studies typically undertaken in the technology and public policy programs at other institutions. For want of a better term, these will be referred to as technology and public policy projects. Most display one or more of the following common characteristics:

1. Clearly the most important hallmark is that the pivotal questions on which a public policy decision depends require answers that are heavily technical in nature. An example would be the nuclear waste disposal problem where the critical issue is whether or not it is technically feasible to isolate nuclear waste from the environment

for long enough so that when it does escape, the health risk is insignificant.

2. A second important characteristic, closely related to the first, is that the policy decisions tend to depend on assessments of:
   a. environmental impact,
   b. effect on health and/or mortality,
   c. risk.

3. The policy issues examined by these projects frequently arise from the technologist's disciplinary work. Typically, they represent an extension of his or her professional work into the policy realm.

4. The policy recommendations developed by successful technology and public policy types of projects may require considerable knowledge of pertinent laws and regulatory practices. They may also involve evaluation of existing regulatory schemes.

5. The choice of policy alternatives does not turn on questions whose answers require extensive knowledge of social science or the use of sophisticated social science analytical techniques. At a minimum it must be possible to make useful progress toward developing policy recommendations without answering such questions.

6. The societal issues that are addressed by successful technology and public policy IQP's are not those of traditional concern to social scientists and which social science theory and empirical research have traditionally sought to illuminate.

The last two characteristics mentioned might be regarded as the sine qua non of successful technology and public policy IQP's. Based on past experience we can safely say that where non-social scientists who lack significant social science training attempt to advise projects dealing with topics of traditional concern to social scientists, the results have not been encouraging. Fortunately, such projects are relatively rare.

Based on examination of past projects it is possible to identify the specific types of social science background that are likely to be of benefit to students working on technology and policy IQP's and their advisors. These are social science concepts and analytical techniques that can help to provide answers to the questions that tend to be addressed or are likely to be required to extend an analysis in order to develop a more useful or complete policy recommendation. Specific examples include the following:

1. Cost/benefit analysis and life cycle costing: The costs of policy alternatives relative to the benefits are frequently an important issue in technology and policy projects. Students working on such projects should be familiar with proper procedures for conducting cost/benefit studies and determining life-cycle costs.

2. Questionnaire preparation and evaluation: Public opinion is frequently an important concern in selecting policy alternatives. This is true even where the central issue is a matter of scientific fact or technical feasibility.

3. Regulatory practices and the legal system: Policy recommendations frequently involve changes in regulations or laws. In proposing changes it is important to understand how regulatory agencies function and how they interact with the legal system.

4. Social science contributions to risk analysis: These include studies of risk perception, utility theory, statistical decision theory, and portfolio theory.

5. Social movements: Social movements and organizations shape and influence the public attitudes that determine the political viability of technical policy options. Understanding the dynamics of social movements can contribute importantly to the analysis of policy options.

In addition to these specific social science methods and concepts it is important for students to have a general understanding of how society functions. While it may not have specific application to a student's project, an understanding of, for example, our economic and political systems provides a context that will influence a student's evaluation of even highly technical policy alternatives.

To what extent are the technology and public policy projects described above meeting the original aims of the IQP? A fundamental aim of the IQP is to create in students an appreciation of how technology impacts society. By highlighting the importance of technology in arriving at decisions on issues of public policy, the technology and policy project would appear to achieve at least this very basic goal. When these projects, in addition, employ some of the specific techniques of social science analysis described above, they also serve to make students aware of methods of analysis in the social sciences and how these techniques may be applied to problems of analyzing the impact of technology on society. These are also important goals of the IQP.

There are very few technology and public policy projects for which social science analysis would not be helpful. In the nuclear waste disposal problem example cited above, costs are clearly a relevant issue as is determining an acceptable level of health risk. Technology and public policy projects can be strengthened analytically and serve the aims of the IQP more broadly when they make use of relevant methods of analysis in the social sciences or humanities. (Steps to be taken to make this happen more frequently are discussed below, after we have examined how the social science faculty have approached IQP advising.)

Interactive Qualifying Projects advised by social scientists frequently deal with the functioning of a social, economic or political system and the role of technology in that system. As with the technology and policy projects, the concern is typically with public policy and the valuation of various policy options. However, technology is viewed as one of many factors that can affect outcomes and is evaluated in a broad societal context along with other influences. Rather than an in-depth understanding of technology, what these projects require is a determination of the facts about the relevant area of technology that are critical from a societal and public policy perspective. Analysis then takes these facts as given and determines how social systems will respond to technological developments. What is essential in these projects is the ability to understand the internal functioning of the relevant social systems and how these are impacted by policy initiatives and technological change.

The types of projects advised by members of the Social Science and Policy Studies department reflect not only their disciplines but equally importantly their areas of specialization within their disciplines. We have conducted projects in a wide variety of areas, including

1. cognitive styles of scientists and researchers,
2. protest movements,
3. public attitudes toward new technologies,
4. statistical analyses of the effectiveness of new technology in education,
5. studies of the relationship between social life, alcohol consumption and academic achievement among college students,
6. evaluation of new medical technologies from the standpoint of cost and medical effectiveness,
7. analysis of the problems of resource and energy supply and conservation with special attention to the potential contribution of new technologies.

This list will grow and change as new faculty are added and existing faculty develop new interests.

Many aspects of the technology/society interface that have been of traditional concern to social scientists or have generated recent controversies in the social science literature have largely been ignored in the advising of IQPs. Limited faculty resources are part of the explanation for the lack of attention given to social science views of technology. But in addition, students take few social science courses and have little opportunity to become exposed to these views. IQP activity reflects student interest which, for science and engineering students, generally flows in other directions. The project mode is not well suited to imparting a broad understanding of the myriad of ways in which, for good and ill, technology has impacted society and shaped human progress. Broad critiques of technology form the core subject matter of most programs in science, technology and society. But it is this aspect of STS study that is most neglected at WPI. It is here that social science course work can contribute greatly.

The members of the Department of Social Science and Policy Studies believe that the two course social science requirement should be used to strengthen and supplement the IQP. The specific types of specialized social science background likely to be most useful in the projects advised by scientists and engineers have been identified above. [This background is available in a number of social science courses including a preparation course for project center students recently introduced jointly by the DIA and SS&PS.] However, we feel that it is equally important to encourage engineering and science faculty who are heavily involved in IQP advising to acquire a social science background relevant to the projects they typically advise. There are various means to this end. Short courses could be offered during the summer as they were in the past. Another possibility would be to develop an expanded, social science oriented, project support module for both students and faculty. The SS&PS department is ready to help in any way it can to assist the technical faculty in gaining convenient access to information about the appropriate social science techniques and concepts.

A broad social science background will be of benefit to those students working in technology and public policy IQP's as well as those who are attracted to projects emphasizing social science approaches and advised by members of this department. We would like to see the students'

preparation in social science oriented toward encouraging them to undertake projects in the areas of concern to social scientists including those that are at present neglected. To this end we have been urging students to meet their social science requirement by taking a two course sequence in a single social science discipline. Several sequences are available. Each begins with a general introduction to the field and then leads to a second level applied course designed to make students conversant with many aspects of the society/technology interface. A primary goal of the higher level courses is to leave engineering and science students with the recognition that social science knowledge is vital in analyzing a wide range of society/techgnology issues and that they are capable of mastering and applying social science methodologies in their project work.

Proceedings from the First National Student Projects Competition in STS

by

Professor John Wilkes, Conference Convener, WPI
Department of Social Science and Policy Studies

WPI, The Society for Social Studies of Science (4S) and the WPI Chapter of Student Pugwash collaborated this last year to hold a national undergraduate project competition and conference in Worcester during the twelfth annual meeting of 4S. WPI and the 4S each contributed prize money and formed review committees, while the Student Pugwash Chapter provided two people to the WPI review committee and organized the Student Conference.

The process began in the spring of 1987 when a call for papers done as undergraduate work during the last five years went out to contacts in Science, Technology and Society programs and Student Pugwash chapters around the country. Advertisements were placed in journals and newsletters where the advisors of such projects might see them. The call was broad, encompassing term papers, undergraduate theses and special projects done as part of internships and student conferences, and of course, IQP's at WPI. Submission required the furnishing of a two to five page abstract, and full papers were required only of those designated as semifinalists by the screening committee. Students rated as semifinalists or honorable mentions were offered the opportunity to present the papers at the November conference.

In the end there were fifty-two inquiries which produced forty-seven valid entries. About half of these came from current WPI students. Most of the others were theses, with one significant exception of the half dozen WISE entries (Washington Internships for Students of Engineering sponsored by The American Society for Engineering Education) which are often described as "case studies."

Twelve projects went forward to the first judging after screening by a five-person committee at WPI. This screening committee also designated categories of honorable mention: "Service to a Government Agency or Voluntary Organization Involving an STS Issue," "Contribution to Technological Literacy of the General Public," and "Contribution to the Understanding of Science and Technology by Children."

The 4S final judging panel consisted of three professionals with much experience as peer reviewers for the field of STS. Yoram Neumann, Director of Graduate Studies at the Center for Technology and Policy (a fifty student program) at Boston University, chaired the committee. Serving with him were Susan Cozzens, editor of the 4S journal, and Rachelle Hollander, Head of the NSF program on Ethics and Values in Science and Technology.

This well known group of scholars was favorably impressed by the work of the finalists, especially the top six papers, which they considered publishable. In the end they settled on a top prize winner and three second prizes covering a diverse body of kinds of work they found easy to recognize but hard to choose among. Rachelle Hollander made the awards on behalf of the committee at the Annual 4S awards dinner and banquet, November 20, 1987.

Certificates were distributed to all other finalists, semifinalists and honorable mentions. John Wilkes of WPI bestowed the semifinalists and

honorable mention awards on behalf of the screening committee. Pam Seidenman, Executive Director of Student Pugwash USA, awarded the finalists certificates. All sponsoring organizations expressed pleasure with the results and congratulations to the students, all of whom would be presenting over the next two days in the Student STS Conference. Other Student Pugwash officials who would join Pam in chairing sessions in this conference included Tad Homer-Dixon, founder of Canadian Student Pugwash, and Steve Kretzman, the Student Pugwash USA chapter coordinator for the national office.

The next national student competition is also being planned. (Rules for the 1988 competition follow after abstracts of the winning essays.) The sponsors currently think that this will become a biennial international competition over the next few years.

Executive Summaries of Prize Winning Essays

FIRST PRIZE WINNER

HEAVY METALS IN THE CONNECTICUT RIVER ESTUARY: ANALYSIS AND QUESTIONS OF APPROACH

by Alison Gee
An STS Thesis, Wesleyan College

This thesis explores the process of scientific study of an issue that holds considerable interest beyond the exclusive sphere of scientific research. It focuses on the problem of heavy metal pollution to the estuarine coastal environment, examining the Connecticut River estuary in particular. A primary concern is to develop an understanding of the complexities involved in distinguishing accumulations resulting from anthropogenic activities, given contemporary geochemical approaches. The relevance to, as well as potential for political application of such scientific information on this topic, is then discussed within the context of a number of contemporary developments in the philosophy of science.

The focus of this study is relevant for a number of reasons. The physico-chemical nature of estuaries makes them important traps of toxic chemicals such as heavy metals that become absorbed to suspended particles. Yet during the process of transport, natural and anthropogenically derived heavy metals become homogenized, making assessment of past polluting activities difficult. It is thus a challenging topic of study both scientifically and socially. In addition, while issues such as the accumulation of toxic wastes in the natural environment require technical assessment, the resulting information has many uses within the political sphere. However, the specific questions which scientific researchers can address may not be appropriate ones for political concern. Use of technical information outside the scientific sphere may be further hindered given the nature of specific scientific methodologies employed in deriving such data.

These various themes are explicitly addressed in three distinct sections of the thesis, and are dealt with on a number of different levels. In part I, a detailed outline is developed from the recent literature concerning the processes of geochemical cycling, fixation, and potential remobilization of heavy metals from estuarine sediments. Discussion points

to the importance of site specific analyses in order to assess potential toxicity resulting from extensive accumulations. Primarily as background, this section also provides a discussion of sources for both natural and anthropogenically derived metal concentrations, on a general level, as well as with specific reference to southern portion of the Connecticut River basin.

Part II then applies the information presented in part I to a study of sediment cores taken from a marine dominated part of the Connecticut River estuary. Possible reasons for observed exponential increases in zinc and copper concentrations over time are investigated. Specifically, association with the fine-grained sediment fraction, and the role of sulfide formation in controlling distributions with depth are focused on. Neither of these parameters is found to be quantitatively significant controls on metal distribution. It is concluded that observed metal profiles with depth are most likely a function of increased supplies from industrial and municipal discharge, rather than the result of diagenetic processes resulting in natural anomalies. Using radioisotopic dating techniques, the on-set of this increase recorded in the sediment is then determined to have occurred roughly 150 years ago. From historic information this is concurrent with industrialization and urbanization of the Connecticut River watershed.

The third section of the thesis examines this topic from a totally different standpoint. Here I discuss the kinds of information generated, and developments that may occur in the process of research that may render such scientific findings irrelevant, unaccessible, or otherwise problematic for use within a political context. The sources of this difficulty, resulting from the nature of scientific methodology itself, are explicitly addressed. This is done within a philosophical context, making use of my own experience in conducting the above research, as well as works by Thomas Kuhn, Mary Hesse, and Ian Hacking among others.

Chapter 1 of part III focuses on the different objectives of the scientist and the decision-maker, primarily resulting from scientific objectives being specifically designed to identify and address "solvable" questions. The use of probability, and otherwise qualified statements, as well as the role of simplifying (although scientifically valid) assumptions in making objectives obtainable are considered. It is recognized that these bases of information may inhibit reasonable political translations of resulting information, which are required if such technical conclusions are to be used in decision-making.

The second chapter of part III addresses the contextual nature of both scientific methodology, and the information it generates. Specifically, the role of shared practice in providing a basis for validating research conclusions, as well as in facilitating recognition of the significance and relevance of new research, is discussed. The way in which the exclusivity of shared practice can limit the accessibility of technical information to a community of specialists is also recognized. The need for greater participation by scientists in political decisions that require technical informing is implied, even if primarily acting as translators. It is argued from contemporary formulations of the nature of scientific methodology, that such participation need not threaten the objective basis of scientific endeavors.

The final chapter of the thesis then reflects on my experience of conducting scientific research on a topic of seeming relevance to social concerns. From Hacking's characterization of laboratory activity as engaging in "phenomena creation," the complete separation of derived

technical information from aspects of the natural environment it claims to simulate is recognized. This theme is then used to point to reasons why the objective of high productivity of scientific information is at odds with a concerted effort to make research conclusions applicable to political concerns. Examples from the research undertaken for part II of the thesis, such as the need for flexibility in research objectives, are discussed. It is concluded that while greater efforts are needed on the part of scientists to make connections to the broader contexts of their research conclusions, it is the very methodology of their study that may thwart even a conscientious effort to inform political debate.

SECOND PRIZE WINNER

THE FIRE SERVICE'S REACTION TO STRUCTURAL CHANGE

by Gregory K. Doerschler

A Major Qualifying Project in STS at
Worcester Polytechnic Institute

This project was completed in January, 1986, as a Major Qualifying Project (MQP) for a Bachelor of Science degree in Social Science and Technology Studies at Worcester Polytechnic Institute (WPI). An MQP is a B.S. degree requirement at WPI similar in nature to a senior thesis. The project was advised by Professor John Wilkes of the Department of Social Science and Policy Studies, and was also carried out in conjunction with the Center for Firesafety Studies at WPI.

The project itself involved an assessment of the current attitudes toward the fire service's future as expressed by the leadership ranks of the nation's large city fire departments. This assessment was carried out against a backdrop of impending changes in the fire services role. These changes are being brought about by external technological developments in fire protection techniques, particularly fire protection engineering.

Utilizing computer fire modeling and an enhanced understanding of the behavior or "physics" of fire, the behavior of a fire in any given structure can be accurately predicted. Structures can therefore be designed or modified in accordance with fire protection engineering techniques to restrict the spread of fire. In essence, a large scale implementation of fire protection engineering techniques would shift the primary fire defense for buildings from an external fire suppression service to the design of the buildings themselves.

Citywide implementation of fire protection engineering practices in a given community would necessitate the creation of professional positions at various levels, which would be filled by fire protection specialists. It would also reduce the need for maintaining large scale fire suppressions forces, which is the traditional role of fire departments. The issue which this project focused upon boils down to a question of whether the fire service would be willing to shed its traditional orientation and shift emphasis to fire prevention by encompassing the new fire protection professionals within its structure. Alternatively, it could choose to maintain a "reactive" suppression stance and become a less prominent organization within the realm of fire protection.

The main thrust of the project involved the research design, data

collection and analysis of a survey sent to high ranking fire officials from large city fire departments nationwide. The survey was designed to assess the respondents' attitudes toward the fire service's future, particularly whether they perceived any crisis or threat, and whether they would support a role change for the service to deal with the perceived threat.

The decision to send a survey to Fire Chiefs from large city fire departments was reached after considerable consultation with knowledgeable individuals in the field. It was necessary to identify the persons or group who would be most influential in determining the future orientation of the fire service. In addition to the large city Fire Chiefs, some consideration had been given to surveying fire schools, rank and file firefighters, fire equipment manufacturers and smaller fire departments. However, due to the authority pattern and role modeling characteristics of the fire service, it was felt that if any substantial changes were to occur in the field, large city Fire Chiefs must at least be receptive to such changes if not the primary movers. Since the 166 large cities identified were spread out across the country, a survey project was the most practical method of data collection.

The survey itself was meticulously designed to get several different types of responses. It included basic factual questions, closed-ended items, semi-structured open-ended questions and unstructured open-ended questions asking the respondent what he thought the future fire service would be like. A section dealing with the respondents' personal background characteristics was included at the end of the questionnaire. At the heart of the survey were five scenarios depicting possible futures for the fire service. Each of these was written with a specific orientation in mind, ranging from high level fire prevention efforts to complete automatic sprinkler systems and hi-tech fire sensing networks. The respondents were asked to rate each of these scenarios in terms of desirability, effectiveness and likelihood of implementation.

Three copies of the survey were sent to each of the city Fire Chiefs in the communities surveyed, with instructions to select three persons with his department in positions of authority whom he considered to be influential to complete and return the surveys. The group of three could include the Chief himself if he chose to participate, but it was not required. Although it would have been desirable to get a response from each Chief, it was more important that the individual who was actually completing the questionnaire identify his rank. It was felt that if a response from the chief was required, some Chiefs could pass the survey along to others to fill it out for them. Data analysis reveals that most of the responses were from the positions immediately below Chief. In all, two-thirds of the survey's distributed were completed and returned.

The survey results were quite enlightening, and somewhat surprising. Since the fire service is seen as a largely traditional organization, it had been suggested that it would be reluctant to shed its traditional fire suppression orientation. The survey returns showed overwhelming support for a general shift in emphasis for the service from fire suppression to fire prevention. The younger and better educated respondents were most likely to support this shift. Also, an anticipated regional difference emerged in the analysis. West coast respondents appeared to be ahead of the eastern U.S. in their fire prevention efforts. This finding confirmed the widely held perception that fire departments on the west coast are more progressive in their fire prevention efforts. It

is speculated that since these cities are newer, they are less bound by the fire service traditions which are so deeply rooted in the older, eastern cities.

In terms of overall responses, the open-ended items in the questionnaire turned out to be an important complement to the closed-ended and semi-structured items. While the latter were used as a basis for most of the statistical findings, the open-ended items provided an invaluable interpretive context for understanding the various perspectives which the statistical findings revealed. Not all respondents elected to provide meaningful comments in the open-ended questions. Those that did, however, were quite explicit in explaining what was wrong with today's fire service and what they wanted to see in the future. Some were very optimistic, stating that the future fire service would be much more professional and more fire prevention oriented. Others were quite pessimistic. They sometimes felt that the service takes a step backward every year, and that the future fire service would be way out of touch with reality.

In all, the project turned out to be a useful examination of the leadership perception in a major social institution facing organizational crisis brought on by external technological development. The fact that nothing of this specific nature has been attempted before means that the fire service officials who participated in the survey may find its results to be of value in preparing for the future.

SECOND PRIZE WINNER

A MODEL FOR ETHICAL RISK MANAGEMENT

by David Guston

A Seminar Paper in Natural Resource Policy at Yale University

A central question in risk management is how we may formulate risk policy in an ethical manner. The ethical formulation of policy is a difficult question in general, and narrowing the scope to risk policy in which we consider such dilemmas as trading statistical lives for money, only highlights the problem. Although there are a number of public risk managers residing in the expert agencies, there is no corpus which determines even the vaguest dimensions or outline by which these policy makers may propagate ethical regulations. This paper provides a model for the ethical management of risk.

Risk has as one essence--uncertainty. Every action contains some innate risk--some probability of an associated loss of values--yet we can never be quite sure of the specifications of the risk in time and space. This essential quality irritates the interaction between risk and policy. We can distinguish and separate procedurally two concepts relating to risk: assessment and management; the former may be considered diagnostic, the latter, therapeutic. In the diagnostic stage of assessment, uncertainty exists but may be exposed and quantified. In the management of risk, the unquantifiable forces dominate. Under this regime of uncertainty, we find the traditional ethical guidelines--the first generation of nonmalificence and the second of utility-- insufficient; a third generation of ethics, concerning distributive justice, equity, and fairness of process, is required.

Although the ethical responsibilities of the risk policy maker toward the public are hazy, responsibilities for other similar

relationships are clearly enumerated. One such relationship is that between the research physician and the human subject of medical research. Since the Second World War, during which Nazi doctors engaged in hideous practices in the name of medicine, a body of codified principles have developed to guide research physicians in the ethical use of human subjects. We can tap this code established by the Nuremberg war crimes trials and by the World Medical Association's Declaration of Helsinki as a model for the ethical conduct of risk policy. The basis for posing such a model lies in an analogy between the policy process and the experimental process. This analogy may be pieced together from Charles Lindblom's description of incrementalism, a type of strategic policy process invoked under the assumption of incomplete knowledge. Recognizing the limits to certainty, strategic planners draw two inferences: one, the subordination of analysis to interaction; and two, the simplification of analysis to the point of "proceeding step by step through trial and error rather than by trying to comprehend a problem in its entirety." Identifying the policy maker as a kind of experimentalist, and specifying that the risk manager controls the exposure of human subjects to risk much as the research physician does, validates the model.

The major obligation of the research physician toward human subjects is obtaining their informed consent for the procedures which entail some risk to the subject. There are other absolute obligations the physician has, which may be summarized: the risk imposed should never exceed the humanitarian contribution of the anticipated result; the researcher must halt the experiment should injury be likely; precautions and facilities for the prevention of even remote risk must exist; the researcher must respect the right of the subject to withdraw from or end the experiment at any time; and subjects of clinical research, who may benefit personally from the procedure, may be exposed to greater risk than subjects of non-clinical research.

The ethical foundations of these obligations are variously the Kantian rule that autonomous beings must never be used solely as a means to an end, the primum non nocere duty of the physician from the Hyppocratic tradition, and the Utilitarian ethic. Although the primum non nocere (do not harm) is a first generation nonmalificence principle, and Utility is second generation, the Kantian rule and combination of the three provide a third generation framework concerned with justice and method. These principles may be transformed into the following guidelines for the risk manager: 1) the informed consent of the public is absolutely necessary; 2) the degree of risk should not exceed the anticipated benefits; 3) there exists a limit beyond which the risk of injury is unacceptable (although this threshold may be higher for those who benefit directly); 4) precautions and facilities for the prevention of even remote risk are in place; and 5) the public is at liberty to withdraw from the risk.

We now proceed to apply the model to questions in risk management policy to examine their ethical basis. We draw the questions primarily from the Delaney clause of the 1958 Food Additives Amendment to the Food, Drug, and Cosmetic Act (S)(c)(3)(A), which prohibits the use of additives shown to be carcinogenic in humans or animals. It was the intention of the 85th Congress, and of FDA and HEW, which concurred with the legislation, to establish a zero risk regulation; but twenty years later, inspired by a letter-writing constituency, Congress circumvented the Delaney clause in allowing saccharin to remain on the Market. The expert agencies have similarly hedged the risk-only statute by establishing the concept of de

minimis risk, a level below which risk is defined as safe. This risk is arbitrary in that it could have been set anywhere, but it is commonly invoked at one in a million which corresponds to a general concept of accidental occurrence or "act of God," for which we assign neither responsibility or liability, and against which it is assumed we cannot regulate successfully. The concept is derived from the common law tenet that the law does not deal in trivialities.

To compare the ethical states of Delaney and de minimis, we proceed through the principles of the ethical code, sifting out judgments about Delaney and de minimis. In an initial examination assuming a correct risk assessment, we find Delaney to be ethically sound but functionally unwieldy, entirely because it is a zero risk regulation. Delaney cannot be ethically suspect if it allows no exposure, but that is an awkward, if not impossible goal. De minimis, conversely, has some ethical shortcomings especially in the assumption that one in a million risk is safe, no matter what the benefits, but it is much more flexible than Delaney.

The worst mistake we can make in policy, however, is the assumption of certainty or infallibility, as John Stuart Mill informed us. The transition from certainty to uncertainty alters our ethical perspective on these two risk management policies. Delaney clause risk management becomes unethical by all principles once the reality of uncertainty is accepted. Delaney maintains that "if it is not safe, it is not in the food supply;" the necessarily true contrapositive is thus "if it is in the food supply, it is safe." But under uncertainty, this is patently untrue. Under uncertainty, de minimis fairs little better because it emphasizes risk/benefit analysis which may be severely imbalanced by error.

Designing an ethical policy of risk management under uncertainty is not a vain effort, though, for we have the guidelines established above. This policy is not fixed because of uncertainty, and it must evolve toward a still more ethical policy as the political process becomes more pluralistic and public consensus can be said to closer resemble the key concept of informed consent. But the infrastructure of any ethical (and flexible) risk management will look like this: the establishment of a risk ceiling (de maximis) above which the government may grant no exposure regardless of benefits; the extending of a lower risk ceiling up to those final limits if the benefits to (only) those exposed are significant, obvious, and accepted; the availability of medical treatment to the entire public, as the entire public is exposed to even a regulated risk; and the labeling of all potential hazards for the information of the public to exercise political or market options to withdraw from the risk. This resulting framework is slightly unfamiliar, perhaps a little unwieldy, but it will stand to ethical analysis.

SECOND PRIZE WINNER

CUDOS AND COMMERCE: SCIENCE ADS AND THE NORMATIVE APPROACH TO THE SOCIOLOGY OF SCIENCE

by Elizabeth Hunt

Honors Paper in English at Indiana University

An advertisement in a recent issue of The Ladies' Home Journal suggests that a certain deodorant has the correct pH balance for a woman. Another states that a shampoo has Panthenol (vitamin B5) "which penetrates...the most listless strand of hair." An ad for an iron and calcium pill includes a graph illustrating the dosage release over time. This ad claims that the solution "to a woman's two biggest nutritional deficiencies" is its "micro-fine iron particles in the exclusive Optisorb Time Release System."

Of what significance are such ads as these, which use the language or images of science, to the social study of science? What do they tell us about how science works? In this talk, I will use science ads from recent popular magazines in order to answer these questions.

Arguably, "science ads" say very little about "real" science: whatever research yielded the ads described above might best be described as marketing research and not scientific research. Indeed, if we take a traditional approach to an understanding of what science is, the appeals made in these advertisements would seem to have no relationship to science.

A traditional sociological approach to science sees science as an institution moving toward an institutional goal. Scientists operate within a set of norms as a means of promoting movement towards the goal and these norms are seen as definitive of science. Robert Merton has written an account of science using this sort of sociological approach. Merton claims that the goal of science is "the extension of certified knowledge." The operative norms of science according to Merton -- communism, universalism, disinterestedness, and organized scepticism -- are referred to by the acronym "CUDOS".

In advertising, it seems we have a direct subversion of each of these norms. In opposition to the communism of scientific knowledge, we have the explicit capitalism of advertising information. In place of universalism (the idea that, "truth-claims...are to be subjected to preestablished impersonal criteria," the claims of ads use criteria which are constructed ad hoc for the specific purposes of promoting a product: "What's the fastest-acting antacid you can buy?" The norm of disinterestedness, which says that the scientist should have no personal interest in his or her findings, is perhaps the one most blatantly violated by the kind of information we find in ads: it is contrary to the definition of advertising that the advertisers should have no stake in what they are selling. Of course, one might say that the scientists who do the research do not have any interest in particular findings, but there are two problems with this. The first is simply that often scientists are hired to conduct a certain type of research by a manufacturer, and this assuredly imparts them with an interest in their findings. The second is that presentation of information in ads is necessarily biased by the advertiser; that is, even if the research could be called disinterested, its selection

and placement in an ad imbues it with a commercial interest.

Finally, advertising discourages organized scepticism and, in fact, advertisers hope that we will swallow their information. This is part of the reason that advertisers make appeals to the language and imagery of science in the first place. Who would question the findings of "a major University Research Institution"? Who would doubt, "Four out of five dentists surveyed?"

We see, then, that one approach to understanding the institution of science would exclude advertising appeals as scientific in any sense, since these ads subvert the norms by which "real" science operates. This type of approach would probably posit that appeals using scientific rhetoric are made to attach some authority to the claims of the advertisers, and leave it at that. We might still want to explore why these ads are so appealing to the consuming public, but their significance to the sociology and history of "real" science would be nil, if we were to take a traditional, Mertonian approach to their study.

In my talk, however, I shall be concerned with whether or not we can dismiss a connection between science and science advertising so readily. American science today is much more like a business than it is like an autonomous body moving toward the goal of increasing knowledge. Science and particular scientific endeavors are funded by various agencies whose goals are much more immediate and local than is the Mertonian goal. These goals may be commercial or political, or they may seek to meet a social need. The funding bodies, such as the National Science Foundation, the American Cancer Society or the Tobacco Council, want to sell the public their particular ideologies, in order to keep the money coming in. Scientists, in turn, are out to sell their particular knowledge and skills to the funding bodies, to their research institutions and to the public at large, so that such expertise as theirs remains in demand. With this view of science, even labeling research "pure" becomes a selling point. This label signals us that this research is to be seen as especially arcane and inscrutable, and the research becomes all the more valuable for it.

This is not meant to be a cynical look at the noble institution of science: often the goals of the finding bodies and of the scientists themselves are admirable. The point is that the goals of science are not purely ideological; many of the goals of science exist right here, right now, and are tied to matters of funding, and the salability of science. "Real" science and advertising share a common goal in some sense, then, and this is sales. Science seeks to sell itself as a way of knowing, and in so doing subverts the same norms as advertising.

Neither is this discussion of science as a business within a political economy meant to negate entirely the influence of the CUDOS norms. We seem to perceive some truth in those norms, or similar ones, for they govern many people's impression of what science is. Advertisers, in fact, want us to believe the information they give us is universal and disinterested. Why would we be tempted to believe information that was described as the product of a "socially-constructed, locally-contigent, purchased system of knowledge?" As consumers of both science and of commercial goods, we want something we can believe, and we will only buy things labeled as the Truth.

How, then, may we say science and scientific rhetoric in advertising are related? We may certainly draw parallels between the institution of science and that of a business, but these parallels might be purely analogical. Science wants to sell its knowledge; businesses want to

sell their products: mightn't they each go about it in a different way? The answer to this is no, for even if we are to say that science and advertising (in general) are related analogically by having the same goal of sales, science and science advertising are directly related to each other. The selling of science qua science and the selling of shampoo or soft drinks via science have an epistemological relationship -- they are parts of the same way of knowing -- and we may see how this relationship works by looking at the words and images of science in advertising. On one level, science ads act as an indicator of how society perceives science and how we use it. On another level, these ads tell us something about the way we perceive truth, what we want to believe and how we go about believing it. The fact that scientific language and symbols appear in these ads and not, say, the language of religion or politics or literary theory, illustrates the highly credible status of science. More interesting, however, is the fact that this information, in the language and imagery of science, appears in ads. This tells us that we make our truth, credibility and objectivity where we choose to, or where others, like advertisers, choose to make it for us.

Abstracts of Finalists

FINALIST

DELIBERATE RELEASE OF GENETICALLY ENGINEERED ORGANISMS: SCIENTIFIC, REGULATORY, AND SOCIAL ISSUES

by

Eric Arn
Colleen Burgess
David Hanlon

An Interactive Qualifying Project at Worcester Polytechnic Institute

Recombinant DNA technology has currently evolved to a point where useful and potentially useful genetically engineered organisms have been produced. Many of these organisms are designed for applications in a natural environment. There is no doubt that before any of these recombinant organisms are deliberately released into a natural ecosystem, they must be thoroughly tested for any unforeseen side effects of their engineered genetics. At present, however, no regulated, standard scientific procedures exist for the testing and evaluation of a genetically altered organism.

Government guidelines and regulations concerning official procedures for the approval of genetically engineered organisms for general release have been produced by several federal agencies and regulatory bodies. These are, however, confusing, often contradictory, and largely unenforced. Many commercial and academic research laboratories have produced recombinant organisms that they feel are ready for environmental field testing, and permits for the testing of several of these have been approved through existing government channels. Unexpected public opposition to such testing and legal action by environmental activists and concerned communities near proposed test areas have forced researchers to

postpone their trials. At the present time only one of the approved field tests has been performed.

The production of engineered organisms for environmental release is such a novel concept that the social implications are mostly unexplored. The American public in general is poorly educated as to the goals, techniques, possibilities, and implications of this new technology. This ignorance has produced widespread fear of recombinant DNA technology as evidenced by the public protest and in measures such as court orders to prevent federally approved tests.

Through this project we have attempted to fulfill several objectives which we believe must necessarily be realized for the benefits of genetic engineering technology to be profitably utilized in environmental applications. First, a review and integration of current scientific literature in biological specialties relevant to the release of recombinants into the environment have been produced. This research includes a review of recombinant DNA procedures used to produce genetically altered organisms and also covers the creation and behavior of specific engineered organisms in the laboratory and the results of preliminary tests. Investigations have also been made into natural methods of genetic transfer and alteration and how these processes may occur or be controlled in recombinants. Research of micro and macro ecology was necessary to determine possible effects of the introduction of engineered organisms into natural ecosystems. The hypothesized selective and adaptive advantages or drawbacks of genetically altered species were also considered to help create an assessment of the risks they may pose to the natural ecological balance.

An investigation of the government agencies, policies, guidelines and regulations which affect a proposed environmental release of a recombinant organism was also performed. This information was simplified in chart form and clearly explained to produce a document that states the current framework of deliberate release regulation. Using this information and that gathered in other sections, we have attempted to evaluate the effectiveness of the current regulatory framework and suggest possible improvements.

Another objective of this project was to determine public awareness of the deliberate release issue using social scientific methods. This was accomplished through distribution of a written questionnaire which we designed, to a large random sample of people. We also interviewed a sample of biologists ranging from molecular biologists to ecologists using questions designed to be correlative with the results of a published interview given to leading national policy makers. The observations made from these two sets of data were then compared and contrasted to find areas where public education on the subject is lacking, and to allow us to recommend methods for remedying the situation. These findings have particularly significant implications for the burgeoning biotechnology industry, where firms need to conduct field tests prior to the commercial development and sale of their engineered organisms.

FINALIST

HAZARDOUS WASTE SITE CLEANUP UNDER "SUPERFUND"

by

David Astrauckas
Chris Boova
Laurie Bouchard

An Interactive Qualifying Project at the WPI Washington, DC, Project Center .

This project, prepared at the National Association of Manufacturers in Washington, D.C., studies the national hazardous waste site cleanup program that resulted from the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. The nature of this subject warrants a brief discussion of background information to illustrate some of the issues involved with hazardous waste site cleanup.

During the 1970's federal legislators responded to the newly awakened public concern for the effects of industrial pollution with a wide range of environmental legislation. In 1972 Congress extended the authority and funding sections of the Clean Water Act to cover the cleanup of spills of hazardous substances. Further, in 1976 Congress enacted the Resource Conservation and Recovery Act (RCRA) which was intended to ensure "cradle to grave" regulation of hazardous wastes.

Some of the shortcomings of environmental statutes until then were effectively illustrated by the Love Canal incident of 1978. Love Canal had been an industrial waste disposal facility operated by the Hooker Chemical Company from the late 1940's until mid 1950's when the site was covered with earth and closed by Hooker. Eventually, the land changed owners and buildings were constructed on the site. By 1978 hazardous wastes had seeped into homes resulting in allegations that attributed adverse health effects to the waste site. The inability of any statute to deal with the type of waste site found at Love Canal, the large amount of publicity the incident received, and the subsequent discovery of thousands of such sites in America led to the enaction of the Comprehensive Environmental Response, Compensation, and the Liability Act of 1980 (CERCLA), or the Superfund.

The Superfund gave the Environmental Protection Agency (EPA) the authority and funds to start cleaning up the most threatening hazardous waste sites around the country. The Superfund also designated liable parties at sites and gave EPA the power to recover cleanup costs from these parties. These potentially responsible parties (PRP's) include waste site owners, operators and waste generators (primarily industrial corporations) who have dumped hazardous wastes at sites.

The EPA has established a complex program of cleanup procedures and policies consistent with CERCLA that are designed to remedy the waste site problem on a large scale. At the heart of this program are the policies and procedures that guide decision-making for individual sites. Since EPA is left the awesome responsibility of making decisions that affect the public, the environment, and the huge number of waste generating companies in America, its actions are constantly subject to severe scrutiny. Much of this scrutiny has resulted in criticisms that question the merits and effectiveness of the cleanup program. The goal of this project is to evaluate the EPA policies and procedures that govern the cleanup of waste

sites throughout the country.

In our effort to evaluate EPA's policies and procedures governing waste site cleanup the first step of the project was to gain as much insight into the cleanup process as possible. This step was accomplished through a literature search for information related to the Superfund program. This search yielded publications by the Office of Technology Assessment (OTA), the Bureau of National Affairs (BNA) and privately published Superfund Handbook. These sources all gave general background about basic cleanup strategies under Superfund.

To detail actual EPA cleanup policies and procedures and their results we performed three case studies of Superfund sites. We chose three cases with cleanup histories that were notorious for being plagued with technical and procedural difficulties. The primary reason for choosing such sites is that the intent of this project is to make policy and procedural recommendations that will increase the effectiveness of the Superfund program. Since little is to be gained from attempting to improve already successful policies, sites with problem-causing policies were studied. The sites we chose also were sites whose cleanup had been started early in the Superfund program. The reason for this criterion is that such sites would have experienced policy and procedural evolution. This characteristic of our sites allowed our studies to witness a broader range of possible cleanup procedures than an already rigid program would reveal. Thus, any conclusions drawn about cleanup procedures would be more broadly based. The cleanups selected for study were the Lone Pine Landfill, the Seymour Recycling Corporation and the Stringfellow Acid Pits.

Information on a cleanup procedures and policies for the three cases was obtained from a wide variety of sources. Due to the high degree of public concern with these problematic sites, a number of investigative congressional hearings were held on some of the sites and highlighted some site cleanup activities. Most other sources were not readily available to the public. Additional information was primarily acquired through direct contact in telephone and personal interviews with EPA officials, state officials, and corporate representatives and lawyers.

The problem posed by hazardous waste sites is significant. Because of hazardous waste sites surface and ground waters have been contaminated and many drinking supplies have been lost. The health threats posed by direct exposure to most sites have forced these sites to be strictly closed to unprotected people. In some instances, as at Times Beach, Missouri, people have been evacuated or permanently relocated because of the potential health risks nearby hazardous waste sites pose.

The scope of the hazardous waste site problem is immense. The EPA estimates that over 2000 hazardous waste sites will require cleanup. Congress' Office of Technology Assessment estimates that up to 10,000 sites will require cleanup at a cost of up to $100 billion. New sites are being added to the cleanup list more quickly than the EPA can deal with them. The ability of the Superfund program quickly, effectively, and practically to solve the hazardous waste site dilemma in America is questionable. Therefore, detailed study of the program as we have proposed is important.

The results of our project are the detailed information obtained about hazardous waste site procedures and policies and the information obtained about the effects of using these procedures and policies on sites. The analysis of our results consisted of an evaluation of the ability of cleanup procedures and policies to address the hazardous waste site problem effectively on both the local and national levels.

From this project's evaluation of waste site cleanup procedures specific recommendations for procedural corrections and policy directions were made that would expedite the cleanup of the nation's dangerous hazardous waste sites. Recommendations were made in the following areas:

I. Cleanup Strategy

The EPA currently follows a policy of complete, single phased cleanup of sites, as opposed to multi-phased cleanups can often overcome the procedural and technical difficulties at sites more effectively than the one-step approach.

II. The role of State involvement at Superfund sites

From our project, we've determined that active State involvement at Superfund sites has many benefits. In some instances, State involvement is necessary to expedite cleanup.

III. The role of responsible parties in Superfund cleanups

Cooperation between the EPA and PRP's at sites is essential. We've recommended that the EPA rigidly follow its stated policy of early PRP identification and notification at sites in order to negotiate with PRP groups on cleanup matters. To facilitate productive negotiations we've also recommended that technical committees within the EPA and PRP's be formed in addition to the currently legally-represented groups found at Superfund sites.

IV. The role of the community at Superfund sites

This project strongly recommends that the community be highly informed regarding the cleanup of local hazardous waste sites. Public information meetings should be frequently held and community querries should be carefully responded to by the EPA.

The project's conclusions also affirm the importance of the resolution of the "how clean is clean?" question.

FINALIST

CYBERNETICS AND CONTEMPORARY LITERATURE: CONTROL AND COMMUNICATION IN THE MODERN NOVEL

by Patrick Brennan

An Interactive Qualifying Project at WPI

Communication is a distinguishing characteristic of human beings. The use of spoken and written language, the creation of visual and performance art, and the ability to transmit knowledge and culture across generations are all traits which set humans apart from the other animals and from our own machinery. Arguably, communication is what humans do best: it is our most "human" activity. The creation of a communication is an act not generally considered amenable to analysis. The writing of a novel or a play, the sculpting of a sculpture, or the creation of a piece of music, is an intensely personal experience. The appreciation of any of these works is also very personal. These things are not usually accessible to the traditional language of science and analysis, which uses terms which are awkward to apply to emotional experience.

Nevertheless, in recent years the language of science has been extended into the realm of human communication. This effort has largely been focused on the functionality of communication, that is, on the structure and efficiency of systems which foster the act of communication, especially electrical signaling systems. However, recently others have recognized that the science of cybernetics, as it is known, is extensible into every realm where there is an act of communication taking place. How has this affected our art, specifically, our fiction?

This project addresses the cybernetic aspects of contemporary fiction. In this report, we examine the history of cybernetics, from which it is apparent that fiction and the roots of the science have always been close in the desire to create sophisticated systems which can duplicate some aspects of human behavior. We detail most of the important ideas of cybernetics. We examine the three major ways by which cybernetics influences the art of fiction: by suggesting themes directly out of the language of cybernetics, by suggesting themes through the new ways that cybernetics makes us think about our relationship with machinery, and by suggesting style through the new ways that cybernetics makes us think about the act of writing fiction as a communication.

In order to complete this project, we needed to understand the theory of cybernetics and be able to relate it to our literary analysis. We needed to able to think beyond the purely physical implications of theory of cybernetics, and to be able to think like a novelist, who is searching for metaphors or images to exploit in his art. Through our art, the ideas of cybernetics influence our culture. Therefore, the ideas that are explored in this project are of interest to artists, scientists, and anyone who is interested in the intricate feedback loops which control the direction of our culture's thought. (Patrick Brennan's project partners were Ralph Desrosiers, Iakovis Iakovou, and Michael Burke.)

FINALIST

NASA AND THE POLITICS OF SPACE SCIENCE

By Pascale Fung

An Interactive Qualifying Project at Worcester Polytechnic Institute

This is a study of the strategies and organization of space science research, and also of the evolution and direction of its development. NASA policy and administrative structure regarding a space science program named ISTP (International Solar-Terrestrial Physics) were examined in order to find out the relationship between its funding patterns, regulation, and the importance NASA places on space science research. This study covered NASA as an organization, its relationship to the space scientists, and perception of the public's knowledge about and interest in unmanned scientific missions. The degree to which its funding and organization reflect the perception of the space science community and/or the public is also at issue.

ISTP evolved from an earlier NASA program called OPEN (Origins of Plasma in Earth's Neighborhood). Study of the history of OPEN and its successor ISTP indicates that is was not favored by the NASA administrators until the mid- 1980s, when it became an international program. Since then, ISTP has been given the highest priority, among new programs planned for solar and space plasma physics. The author wishes to study the various political, economic and scientific reasons that led to this pattern of increasing acceptance. Perhaps the underlying logic, if there is one, can be applied to studying the development of other space science programs as well.

The scientific rationale and objective of ISTP are also of interest in this study, based on the belief that this program signifies a new and more quantitative phase in the development of space science. The significance of ISTP is that it represents the transition of space science from the exploratory to a productive and predictive stage. This transition has evoked conflicts between the science community and NASA administration. It is therefore necessary to understand the basic science of ISTP, the applications and implications of its outcome, its potential for new discoveries and understanding. It is unique in its ambition to record in situ measurements simultaneously throughout geospace coupled with readings from ground-based measurements.

ISTP contrasts sharply with other NASA programs that consist primarily of space technology, new theories and findings. ISTP studies the near earth processes which reveal basic physical mechanisms and have applications in many areas of human endeavor. Theory development is well advanced and joint efforts for detailed testing are needed. The quantum leap in necessary funding associated with change in the state of the field led to a long period of delay and negotiation on NASA's part until a suitable justification could be found. NASA's new politico-organizational appreciation for this project can be found in terms of the funding level and management structure of ISTP. A comparison with other programs also reveals the extent to which NASA has come to support this research program. A change in NASA's attitude towards space science may be under way, but it is hard to tell because of special political circumstances that might explain NASA's sudden interest in this mission.

NASA's perception of public interest is of special concern in understanding its support of space science. The author made an effort to find out the various means that NASA uses to communicate with and inform the general public. The author also learned about the opinions of the NASA administrators and other scientists on this issue. A closer look at how NASA chose to publicize ISTP, to what extent the public is informed about ISTP vis a vis other NASA programs, helps one to understand the creation of NASA's public image. The degree of NASA's acceptance of public opinion can also be evaluated. It is also essential to know the effect of public interest on NASA's decision making. This study together with a survey on public opinion, could be used to evaluate how well NASA has represented and provided for the national interest. Such a survey study is currently in preparation by other project groups at W.P.I. This study was just a first step.

The author's knowledge about ISTP was further enriched after going through many official documents and information obtained from NASA including a video tape about ISTP program which is still unavailable for public showing due to sensitivity at NASA about publicizing unfunded projects.

To explore in detail all the issues mentioned above, the author has done some interviews with four key NASA administrators (most of whom are also space scientists) who have been associated with the program for some time and know its history. An additional 16 interviews were done with scientific investigators from a number of different experiment groups scheduled to launch instruments in the ISTP program.

To expand the coverage of scientists involved in the program, 50 more scientists (25 U.S., 25 overseas) were contacted by mail questionnaire to see if the scientists interviewed were unusual in their views. Answers to the questionnaires can also be part of the evaluation of international understanding regarding ISTP.

A presentation of some of the finding of this study based on interview results and NASA documents was done in front of about 80 people. The audience consisted of parents and other family members of W.P.I. students. In the presentation, the author talked about the history of space plasma programs especially about OPEN and ISTP. The scientific rationale and objectives of ISTP were explained briefly to the audience and were further elaborated by viewgraphs made by ISTP administrators in NASA headquarters. The author also mentioned the scientific community's commitment and readiness, institutional implications, feasibility and costs of the proposed mission. Moreover, the potential and uniqueness, the international involvement and its significance, the contributions and other significance of ISTP program were pointed out and explained to the audience. Two sets of questionnaires were passed out to the audience, one before and one after the presentation. The outcome indicates that learning about ISTP had a considerable impact on them. For one thing, they showed a higher confidence and interest in our space agency after they learned more about the other side of the space program, the unmanned space science missions. However, their reaction was tempered by concern that the space program was not properly balanced between the manned and unmanned activities and that the public was not being kept well enough informed about the space agency's activities. This reaction suggests that the NASA position that the public cannot understand or appreciate and will not support classic unmanned space science missions for their own sake is suspect and in need of review.

FINALIST

MUCH ADO ABOUT NOTHING

by Karen K. Hankins

A paper in History of Science, University of Michigan/Student Pugwash

Two traditions exist within the study of the history of science. Externalism is the view that science is a part of culture like philosophical ideas and religious beliefs, thereby making history of science a part of general sociocultural history. Internalism is the view that science is primarily an abstract enterprise, insulated from social, political and economic circumstance, which highlights conceptual frameworks, methodological procedures, and theoretical formulations. Few historians believe either view entirely. All historians of science believe the period from 1550 to 1700, know as the Scientific Revolution, to be pivotal. Internalists see a fundamental transformation in thought about nature whereas externalists see a fundamental transformation in attitudes toward science. I argue that during the period a more basic and more interesting activity was occurring; the birth of a new world view which incorporated and venerated the values and cosmology of the intellectual movement.

World view is the comprehensive philosophy of life, nature, and human relations. The old world view was dominated by religion and, pictorially, the "smothering embrace of metaphysics". The rising world view was dominated by science. The primary actor was changing from God to human. Mysterious, unknowable Nature was transposing to intelligible, controllable nature. Rather than passive acceptance, problems were attacked with active resolve.

Why do I feel that the transformation of world view is more important than the intellectual movement? Ideas do not drive societies give birth to ideas. Clearly this is a sort of "chicken or the egg" distinction. For me, however, ideas are not entities which flit in on wings from idealand; ideas come from people and people come from societies. Also there are growing bodies of evidence which indicate a link between ideas and the cultural environment of people.

Another reason the birth of a new world view fascinates me is that religion had been the dominant explanatory model (and therefore the keystone of any world view) for centuries. Science is quite an upstart to upset such an entrenched system yet the secularization of the Western world occurred quickly. What sorts of factors engendered the birth of my present day society's world view are necessarily compelling.

If science as an explanatory model is the keystone for a new world view, it should be noted that there is nothing intrinsically special about science which would give it a privileged status as an explanatory model. That is, science has no special access to the truth. Our belief in science relies on faith as does religion. But many people do <u>believe</u> that science does reveal the truth and therefore, humans have access to all knowledge if they only apply enough science to it. This belief may be a part of the explanation of the transformation of world view but it does not give science a privileged status as an explanatory model.

If we then accept the focus I propose, that the change in world view might be a fruitful area of scholarly endeavor, what will be the job

of the historian of science? While I am not an expert on the methodology of history, I am not necessarily suggesting a change in methodology. Historians could use their same tools but change their subject from science itself to the society which berthed it. I agree with Marie Boas Hall that, to a certain extent, the internal content of science must be explored before the external factors can be explored.

It also might be true that traditional methodologies may not yield understanding of why a new world view was needed or developed. This is not to reject the activities of historians of the science of ideas but it may deny them the primacy to which they have become accustomed.

One new method of study is the sociology of knowledge. Lynn White suggests that the problem with printed primary sources is that what we may be looking for is so unconscious that it may not be entirely revealed in language.

The controversial field of sociology of knowledge uses the tools of sociology hopefully to describe society in such a way that we may understand its choices. It is a very new field with a small empirical base. Sociology is also fraught with epistemological problems of importance to history. For example, the surveyor and the surveyed must share a common language and social background if the responses are to be commensurable. Yet, in history, we can never share the same language with the past. Also there are different views concerning the work of sociology. Some feel work is completed once "understanding" of the social world of the actor has been achieved. Others feel interpretation is only the start of explanation since hidden rather than readily comprehensible forces are powerful social influences. I reject this second view for two reasons. One is that if we cannot provide evidence for it, then we are purely speculating. The second reason is everything about a culture is in a culture and will be reflected in some way. It is not within the scope of this paper (nor this author) to thoroughly examine the merits of sociology as a tool in history. I do agree with Gary Abraham, however, in that historians must overcome their "general blindness to the motivating constraints of cultural values and their inclinations to allow individuals to have only the most conscious, or if not conscious, self-serving motives."

FINALIST

ARCHAEOLOGY AND POLITICS IN ISRAEL FROM 325 AD TO 1986

By Joyce S. Kline

An Interactive Qualifying Project at Worcester Polytechnic Institute

One area of study of the Interactive Qualifying Project (IQP) examines the "interaction of science and technology with the humanistic and non quantitative aspects of culture." Archaeology as defined by Webster's Seventh New Collegiate Dictionary is the "scientific study of material remains (as fossil relics, artifacts, monuments) of past life and activities." Therefore, archaeology is indeed a science. This IQP relates technology with society by studying the relationship between archaeology and politics in Israel from 325 Ad to 1986.

Since 325 AD a relationship has existed between archaeology and politics in Israel. A discussion of this relationship has been presented in an IQP where four main societal issues for exploration of the Holy Land are discussed: religious pursuit, territorial expansion, scientific curiosity, and nationalism. An example from each of these areas will be presented.

A. Religious Pursuit

Religious pursuit provided the initial interest in Palestinian archaeology. In 325 AD, the Empress Helena, mother of Roman Emperor Constantine, traveled to Palestine to enshrine the sites of Jesus Christ. Following her journey, it became popular to travel to the Holy land to locate sites of religious importance.

The missionaries excavated for their country as well as for their religion. In 1819, Levi Parsons and Pliny Fisk traveled from Boston to Jerusalem to spread Protestant Idealism. Their work paved the way for other missionaries. Throughout the 1800's missionary involvement in archaeology continued. The French Dominicans, Augustinians, and White Friars all excavated in Jerusalem hoping to find monuments of religious significance. Today missionary activity is a strong motivating factor for pilgrimages to the Holy Land. Although excavation for religious pursuit may appear to have no connection with politics, it, indeed, does. The missionaries, all religiously motivated, represented their respective countries.

In examining this topic, it is evident that the other three main societal issues for excavating can be discussed under this subject. From 1535, when King Francis I of France signed a treaty with Sulieman the Magnificent to gain the "right of protection" of the holy sites of France, European countries began to assert their claim on the Holy Land through archaeology. Great Britain, Germany, Prussia, and America all sent explorers and established excavation societies as a way of asserting a presence on the land. Of all these countries, England through the efforts of the Palestine Exploration Fund (PEF) conducted the most excavations and "borrowed" a number of artifacts to be placed in British museums. During World War I, the efforts of the PEF were realized as the topographic map which had been constructed during the previous years provided the Allied powers with knowledge of the land. The British expansion into Palestine

before the war also caused the League of Nations after World War I to establish Palestine under British control.

Today, expansion of Israel is an important topic. Some organizations, like the ones interested in excavation on the West Bank and also at the Golan Heights want to see the boundaries of Israel increased. However, the Arab countries not only protest this expansion on the West Bank and Golan Heights, but are trying to put an end to the state of Israel. The reasons for expansion differ now than in the past, but the concern over this piece of land is still the same.

C. Scientific Curiosity

Another aspect of the linkage between archaeology and politics is the effect of technology on archaeology. Technology has not only affected the science of archaeology, but also how archaeology is perceived by citizens of Israel, specifically the ultra orthodox Jews. The ultra-orthodox will do anything to prohibit archaeology and prove that the archaeologists are only causing problems. They believe that the excavation of holy places is sacrilegious, not acts of unearthing history.

Another aspect of scientific curiosity, is how scientific progress has changed archaeology. In 1810, Lady Hester Stanhope conducted the first scientific excavation when she systematically unearthed several huge pillars at Ashkelon. In the years following, all other explorers utilized her method of systematic exploration. With improving technology, archaeological methods also improved.

D. Nationalism

A sense of nationalistic pride resulted from territorial expansion of the European nations. All of the explorers and archaeologists who excavated in Palestine exhibited through their efforts nationalistic spirit to their country as well as the world. Although most countries sent explorers to Palestine, the average citizen would learn about archaeology through the antiquities these individuals brought back rather than through the reports of their findings. Antiquities removed illegally from Palestine provided a country with a sense of power and prestige. These objects would often be placed in special galleries and exhibits in museums for all citizens to view. Nationalism can thus be examined under two broad topics: excavating for the cause of one's country and obtaining antiquities from the Holy Land for this nation. Both of these reasons for excavating caused the average citizen to become more aware of archaeology and its importance to his/her nation and the world.

Therefore, it can be concluded from the few examples presented under each topic that archaeology affects politics and politics affects archaeology. The societal implications are obvious. Whether one excavated for religious pursuit, territorial expansion, scientific curiosity, or for nationalism, a political (social) connection exists. Throughout history the connection has existed. Fortunately or unfortunately, the framework has been laid for this relationship to continue in the future.

FINALIST

THE ORGAN FARM DEBATE: ETHICAL QUESTIONS, UNETHICAL CONDUCT?

by Erol Onel

Term Paper, Williams College

Bypassing standard scientific community guidelines, bickering across journals, jumping from experiments on non-primates to the medical treatment of humans -- none of these should be the way science is conducted. But in their haste for the power and glory of being the first to use the fetus as an organ farm, some scientists have conducted themselves in precisely this manner, spreading false hopes based on incomplete research. Hospital review committees have behave no better allowing the admittedly experimental technique to continue, to flourish, and to be packaged as a cure. Why? In order to understand, we must examine the scientific background.

The root cause of many diseases is the degeneration of neurological tissue, e.g. the death of brain cells. Direct evidence has shown such death to be the cause of Parkinson's Disease and Huntington's Chorea, and to be implicated in many others. One possible way to treat these diseases would be to implant replacement cells in the brain and then take advantage of the neuronal phenomenon of collateral sprouting, which would affect the transformation of these surrogate cells into new, functioning neurons. Just such brain grafts have already been attempted for the treatment of Parkinson's disease. The grafting procedure involves selecting cells which perform the same function as the part of the brain which has ceased to work, in this case the dopaminergic cells of the substantia nigra. Currently preferred procedure selects dopaminergic cells from the adrenal gland of the kidney; they are than ground and administered by cannula into the patient's head, where they proceed to take root. This graft has so far been performed in humans only 19 times, first in Sweden, but now also in Mexico and the United States. Unfortunately, results have been less than completely successful. In the past four months, surgeons in Mexico have refined the technique and there is some hope that their patients may now be on the track to a permanent recovery. However, no patients have yet exhibited significant improvement over periods of longer than a year; in fact, the patients treated by the Swedish team have, after an initial improvement, significantly worsened. Of course, every day a patient survives is a new achievement, and the technique is so recent that new data are continually being collected, but the cure-all that was hoped for has certainly not yet arrived.

Changing the methods, in an attempt to improve the results, brings us to the issue at hand. Live neuronal tissue, one plentiful source of which is aborted fetuses, would be a better replacement for dead neuronal tissue than cells of the adrenal gland. However, using neuronal tissue brings up some rather serious ethical questions. As a matter of fact, it must be remembered that there are two levels of ethical questions here: using the fetus as an organ farm (fetal brain - adult brain), and using this untested, experimental technique at all (adrenal gland - adult brain)! Some scientists, in their understandable desire to advance the procedure and apply it to patients, have all too hastily dealt with the ethical

issues involved. This has provoked strong critical reactions from other scientists, angered by what they perceived to be reckless disregard for both levels of ethical questions.

For example, reactions of the scientific community to the first brain graft, performed in 1982 by Dr. Lars Olson and Dr. Ake Seiger of the Karolinska Institute, were swift and practically uniform. Surprise, indignation, and outrage greeted the news that Olson's team had actually applied these experimental techniques to human beings. Dr. Richard Wyatt, Chief of the Neuropsychiatry branch of the National Institute of Mental Health, spoke for most by saying, "The first reaction was what anyone would feel - relief that the patients had survived and were well. Beyond that, I would not have expected much because I did not think that we were ready yet." The sentiment was echoed world-wide.

Drs. Olson and Seiger defended their actions, however. Dr. Olson justified his use of the path-breaking, still experimental technique by recalling when it was first asked of him, "In 1982 we had no good animal model in primates ... When Erik Olof-Blacklund, the neurosurgeon who worked with Parkinson's patients at the Karolinska Hospital, came to me and asked to try our methods in patients whose symptoms could no longer be relieved by drugs, I had doubts in my own mind. But eventually I concluded it would be almost unethical not to try." Dr. Olson hastens to add that he followed all of his institution's normal procedures on matters which involve questions of ethics. He states, "We went before the ethical committee ... and received permission to proceed with 10 cases. The committee set down three conditions: the patients must be relatively young; they must have no dementia so they could be fully informed of the experimental nature of the procedure; and all conventional therapy must have failed." So despite the fact that this research was in its infancy, the hospital elected to proceed with it.

One must wonder, however, just how strict and unbiased the ethical committee of the Karolinska Institute was. Knowing that this is a "hot" topic, knowing that the institution which performs successful brain grafts first will receive praise and publicity, knowing that a huge amount of money could be in the works for the cure of Parkinson's disease, all must have colored their standards. For example, the ages of the first four patients on which the surgery was attempted were: unreleased, 46, 65, and 47. Is this really relatively young?

Although scientist spoke out against the Swedish implants, most researchers -- not wanting to be left behind -- did agree that it gave a strong impetus to their own efforts. Dr. Carl Cotman, a researcher at the University of California at Irvine, said, "It was a real shot in the arm. It got the public excited, it got students excited, and it brought a lot of interest to the field that had not been there before." This sudden rush of interest could be likened to the initial flurry of activity in the field of cardio-thoracic surgery in the mid- 1960's. However, like the heart miracles of twenty years ago, some disturbing questions have arisen. Let us not forget that the brain treatments, as performed with adrenal tissue, have not been particularly successful. All but one of the 19 patients are presently no better off, or even significantly worse, than before surgery was begun. In view of this lack of success, and remembering that these operations were ostensibly performed to benefit the patients, and not the doctors or the institution, the question arises: why was the surgery attempted at all? Also, if it had to be attempted, did it not make sense to try it with neuronal tissue, potentially a more successful tissue type

than adrenal?

Dr. William Freed, a neuroscientist with the National Institute of Mental Health, has performed tissue transplant experiments on rats. The transplants using rat fetus neuronal tissue gave much better results than those using adrenal cells. Dr. Freed stated that fetal neuronal cells always gave some positive results, whereas, adrenal cells yielded radically inconsistent results; the team would obtain good results some of the time, and practically none using other techniques. Dr. Olson knew of these outcomes, and apparently considered and dismissed the possibility of using aborted fetal brains as the source of tissue. He stated that the use of, "...brain tissue from aborted fetuses ... we thought that to be ethically impossible." But it should be noted that Dr. Olson's lab has, indeed, worked on brain-to-brain implants using rats and other animals. It should also be noted that all reports indicate that the lab has simply not been as successful in using neuronal tissue as in using adrenal tissue. Had they been, who knows if they might not have wanted to skip the use of the adrenal gland and gone straight for the more controversial, more eye-catching, and possibly more successful use of the fetal brain.

It seems obvious that some of the parties involved in the research of brain tissue transplants are guilty of unethical conduct. But in striving to avoid the tissue of whether the fetus should be used as an organ farm, we have raised more problems than solved by turning to a questionable substitute. Rather than use adrenal gland tissue at a time when experiments clearly indicate there to be a better alternative, albeit one fraught with serious ethical dilemmas, the research community should focus its efforts on improving its knowledge and techniques of neuronal tissue transplants in animal models. Because of the potential benefits of live neuronal tissue transplants, we must squarely face the issues involved in the organ farm debate. More research is necessary, more verification, more time. During this time, the ethical questions that need to be worked upon will be. They may not be solved, true, but answers will certainly be expressed and argued about. Only after we know a better way to proceed, should we continue with the organ farm debate. The fetus as an organ farm could be a great help to our society, if only we do not attempt to go quickly. In striving to reach great heights, we may find ourselves falling flat on our faces.

FINALIST

CONTROVERSIES AROUND THE INTERNATIONAL STANDARDS FOR FREIGHT CONTAINERS

by Hercules Vladimirou

WISE (Washington Internships for Students in Engineering) essay; Duke University

In the Western world the voluntary consensus process has traditionally been the means by which industry develops the standards that form the basis for free market commerce while providing protection from costly mandatory government regulations. This system is also used by the International Organization for Standardization (ISO) in developing standards to facilitate international trade.

Nevertheless, the voluntary consensus standards process faced a severe challenge from the developing world in the case of international standards for freight containers. The merits and limitations of the system were among the main debate issues confronted by the United Nations Conference on Trade and Development (UNCTAD) during its meetings on Container Standards for International Multimodal Transport between 1976 and 1978.

This paper traces the evolution of international standards for transport containerization technology. The technical aspects of the standards are examined along with the political controversies aroused with the introduction of the ISO standards, and their implications for international trade and the economies of the developing countries in particular. The development of the standards for freight containers was not particularly challenging from a technical perspective. However, the introduction of the standards caused a political stir of global dimensions that led to heated debates at international forums. The effectiveness of the standards development process was questioned, operating procedures of international institutions were challenged and important economic, political and legal questions concerning international trade were raised. This paper presents a case in which seemingly simple technical decisions had widely significant international repercussions.

Freight containers were introduced in transportation systems in the United States during the 1930's. They were the first units that could be demounted from chassis and transferred to different transport modes without unloading the freight. Containerization had obvious advantages of security and reduction of handling time and cost, providing a versatile alternative to traditional loose-cargo handling methods.

The overwhelming implications of containerization were recognized early by several shippers who realized that the development of international standards would be essential for the global adoption of the new technology. Discrepancies in the transportation capabilities of the various countries, government regulations and legal restrictions had to be taken into consideration in developing consensus standards. Various impediments were overcome through compromises and general agreements among the participants (mostly developed countries) leading to the introduction of a series of ISO standards for freight containers in the late 1960's. These mainly covered the aspects of dimensions and load ratings, design specifications and testing procedures, identification marking codes and

handling.

Container traffic witnessed tremendous growth rates after the introduction of the ISO standards. However, the new technology was accepted with much skepticism by developing countries as it was exceeding their transportation capabilities due to the lack of adequate infrastructure. Containerization caused severe problems in their port and inland transport systems, threatened to create labor problems and imposed considerable investment requirements disproportionate to the capacities of their limited resources. Furthermore, it was pointed out that certain classes of containers were inappropriate for the raw materials that constitute the bulk of exports from the developing world, thus burdening those countries with the empty return costs. As a result, the developing countries felt that the drafting of the ISO standards without their participation was detrimental to their basic interests.

By 1978, the ISO achieved positive resolution of some but not all issues. As the debate on container standards was subsiding and emotions were tempering, yet another "storm" erupted in 1982 with the introduction of revolutionary proposals for a new generation of containers. The original series of containers were designed to withstand the worst loads of all transport modes to which they could be exposed. Therefore, all containers were structurally imposed with a weight penalty due to the stringent requirements of marine transport. As land-based container traffic grew considerably, it was recommended to alter the design philosophy so as to eliminate the dead-weight penalty. The proposals called for changes in dimensions and design specifications of the containers, requiring that new transporting units (vessels, rail cars or trailers) be designed to protect the containers, instead of designing the containers to withstand transport forces of every mode. The rationale behind the proposals was geared towards transport economics. However, the proposals provoked strong reactions, this time from shipping lines and regulatory agencies in industrial countries. A variety of technical and economic objections were raised to the new ideas which came under consideration. An interesting and lively debate was simulated by the new proposals which was not concluded at the time the original paper was written. A number of ISO/TC 104 meetings were needed before a compromise decision could be reached during the meeting in Ottawa, Canada in June, 1987.

Abstracts of Semi-Finalists and Honorable Mentions

SOLAR PV INTERACTIVE EDUCATION

by

Tim Beals
Curtis Clark
Thomas Goon
John Mileski
Maril O'Brien

An Interactive Qualifying Project at WPI

The need identified in this IQP is that of science education for children. The proposed solution is an interactive exhibit at the New England Science Center. The design, construction and testing of a prototype exhibit, which the Science Center will eventually display, serves to accomplish the implementation goal.

The problem identified in children's education was a potential lack of proper motivation. The role of the young student in school is often that of a passive spectator. In this setting, motivation for learning is furnished by a reward system in the form of grades. Making learning a more participatory event should produce a more "interest based" motivation to learn. Learning is then undertaken as an end in itself and there is no need for any artificial reward. Simulation and gaming is a way of making learning a participatory event. Interactive exhibits in museums provide an excellent example of simulation and gaming and a solution to the problem of motivating children to learn.

The New England Science Center is the ideal place to create an interactive exhibit. After much thought about the subject matter of the display, it was decided that it would present "solar tracking" from two perspectives: nature and technology. The example from nature is that of a sunflower following the sun in order to maximize energy collection. With regards to technology, photovoltaic cells follow the sun for the same reason. The nature-technology parallelism makes technology seem formidable by relating it to something children have already experienced.

Actually implementing the solution to the perceived problem is another story. After carrying out research in educational psychology, museum education, photovoltaic tracking, plant tracking, and nature technology interaction, a design for the display was created. The display uses the child as the tracking mechanism for a "photovoltaic sunflower." A simple meter is used to measure performance. Descriptive material is presented to help reinforce the concepts of the exhibit. After participating in the exhibit at his/her own pace, the child will have greater confidence in his/her ability to learn. Eagerness to learn will stem from increased confidence in one's abilities.

ENVIRONMENTAL CONSIDERATIONS AND WASTE PLANNING ON THE LUNAR SURFACE

by Randall Briggs

An Interactive Qualifying Project at WPI

Lunar operations in the near future will generate waste management problems. The purpose of the study was to identify environmental considerations arising from lunar manufacturing facilities. The operations chosen for the initial base were developed through discussions with various NASA officials and individuals in industries closely related with the space program. The goal of the study was to initiate conversation on fundamental questions needed to be answered before building lunar facilities.

During the development of the study, the following assumptions were taken:

1. The base will have a 15 member crew.
2. Obtaining oxygen fro ilmenite ($FeTio_3$) will be the primary base function.
3. Nuclear power will form the central power supply on the surface.
4. A semiclosed life support system will be employed with food resupply from earth.

At present, many questions exist as to what will be done with refuse arising from man's existence on the lunar surface. What are the legal restrictions for nuclear power use? Will chemical transportation create a significant lunar atmosphere? These are several of the many questions that confront planners of the lunar base. In order to achieve the best possible results from the operation, environmental questions like these must be addressed.

This paper recommends that NASA begin to study the international issues arising from planned activities on the moon. By either private study or committee, the legal responsibility of the United States to the international community must be determined. In addition, the international consequences of their planned activities must be ascertained. In this manner, the legality and environmental impact of proposed lunar activities in addition to their technical and economical feasibility can be balanced. Final decisions by NASA must compromise between all these considerations, not just the latter. Steps must begin to determine the ramifications - technical, environmental, and international - of planned activities on the lunar surface. It is not too soon to begin to address the impact of man and his lunar activities, both on the moon and in the international arena.

CHLOROFLUOROCARBONS IN THE POLITICAL ARENA

by Eddie Beres

University of Nevada-Reno
ASHRAE-sponsored WISE

For a number of years now, chlorofluorocarbons (CFCs) and various other gases have been accused of harming the earth's atmosphere in two ways referred to as: (1) the greenhouse effect (or climate warming) and (2) ozone depletion. The greenhouse theory states that the chemicals known as "greenhouse gases" absorb infrared radiation as it tries to leave the earth's atmosphere, resulting in climate warming.

There are a number of gases besides CFCs involved in these problems: carbon dioxide (CO-2), methane, nitrous oxide, ozone, carbon monoxide, and a few others. Ozone gas emitted to the atmosphere is considered a problem because even though it may add to the total ozone column, it does not reach the stratospheric layer (the region of the column 9 to 30 miles above the earth), and ends up working as a greenhouse gas by absorbing heat escaping from the earth.

CFCs are often targeted for regulation because their sources are known (they are all man-made). The other responsible gases are produced from such things as combustion processes and agriculture. Furthermore, of the many uses for CFCs (refrigeration, air conditioning, sterilants, cleaning agents, aerosol propellants, and making plastic foams) some are viewed as "non-essential" and for others, substitute chemicals may exist.

Recent Senate hearings have discussed CFC regulations. The severity of any regulations and the speed with which they may be implemented can depend heavily on public pressure. If the pubic is led to believe that CFCs are the major cause of a threat to the earth, they may respond with fierce determination to save their planet. It is conceivable that they would endure slight changes of lifestyle in the name of ridding the atmosphere of the dreaded chlorofluorocarbons. When the first reports of ozone depletion from CFCs came out in the mid 70's, consumers wrote more letters to Congress on the issue than any other since the Vietnam War. With increased future media coverage, perhaps a new record would be set. The important contributions from other gases will, hopefully, not be forgotten by those who form policies whole serving the voting public.

The EPA is under court order to make a decision on CFC regulations by November of 1987. After spending the summer studying this issue, I think that no U.S. unilateral restrictions on these compounds will be imposed before that time, but that the EPA will choose to further regulate CFCs in their 1987 announcement. The first steps are likely to be small and will probably focus on CFC-use in foam-making. Depending on the levels of cooperation exhibited by other nations, perhaps some limits on the use or production of CFCs will soon be set, encouraging the use of alternate chemicals and the increased recycling of chlorofluorocarbons.

GOVERNMENT IMPACT ON ENGINEERING EMPHASIS

John C. Feltz

University of Dayton, Dayton, Ohio
Student Member, IEEE

Written in association with the Washington Internships for Students of Engineering (WISE) and the American Society for Engineering Education (ASEE)

WISE is a ten-week intensive research internship held annually in Washington, DC, for approximately 18 junior-level college engineering students. It focuses on the relationship between engineering and public policy. Each WISE participant is expected to complete a publication-quality paper as part of his or her studies in Washington. WISE is underwritten by the ASEE and more than a dozen professional engineering societies, with academic credit granted through 1986 from the University of Washington, Seattle, Washington, and currently from the University of Oklahoma, Norman, Oklahoma.

The author, sponsored by the IEEE, participated in WISE during the summer of 1986. He examined how the U. S. is undergoing an evaluation of traditional economic thought in the face of global competition. Several factors can be identified as contributing to the problems of engineering emphasis and utilization. Governmental policy underlies several of these factors. Several of these policies are amenable to certain changes. These changes should serve to improve engineering practice and restore American economic competitiveness.

This paper examined policies of the United States and Japan, specifically policy affecting engineering development practice, the part of the product-making process most intensive in engineering, design, and prototyping. The paper attempts to identify a significant difference in emphasis between the two nations in the area of engineering development; explain the policies that contribute to the difference; and offer suggestions for modification of United States policy to change the emphasis for the general benefit of all business.

The following recommendations were made for changes in U.S. policy. The need for these changes stems from analysis of the government policies contributing to the EEP. The recommendations have been chosen with an eye toward high leverage: the smallest policy changes that can produce large corrections of the problem. The recommendations are:

The Justice Department should consider global market shares in determining the competitive state of industries.

Cooperative research efforts in science, technology, and engineering should be encouraged.

Capital costs should be reduced by encouraging savings and equity investments.

Marginal tax rates and capital gains taxes should be reduced.

Depreciation schedules should be improved to encourage investments in

new plants and equipment.

R&D tax credits and incentives should be improved and increased.

Defense systems should be specified to allow use of off-the-shelf hardware where appropriate.

Funds should be allocated for research and education on manufacturing technology and advanced design techniques.

Implementation of these recommendations will be difficult, but should significantly improve the practice, use, and results of engineering in the U.S.

ENVIRONMENTAL IMPLICATION OF THE 1983 EXCLUSIVE ECONOMIC ZONE (EEZ) PROCLAMATION: CASE OF THE STELLWAGEN BANK

by Joshua Hassol

Wesleyan University

On March 10, 1983, President Reagan signed a Presidential Proclamation creating an exclusive economic zone (EEZ) extending 200 miles seaward from all coastlines of the United States and its sovereign territories. With this proclamation, the U.S. claimed the right to explore and manage all living and non-living resources within 200 miles of its shores. The declaration of the EEZ effectively doubled the territory of the United States. This new territory was, and is, largely unexplored.

The issue of management is central to many considerations of the EEZ. From an environmental perspective, it is essential to understand the policies which are emerging concerning the use and protection of this vast new domain. Through a case study of offshore sand and gravel mining, I have presented examples of the kinds of technical, environmental, economic and political issues that are, and will be, paramount in the shaping of such policy.

In its study, the Bureau of Mines selected Stellwagen Bank, a large underwater glacial deposit, as a prime target for exploration as a possible source of aggregate for the BMA. There are several major reasons for the Bureau's interest in Stellwagen. To begin with, although the Bank appears to be composed almost entirely of sand, there may also be several large deposits of gravel. Also, the Bank is reasonably close to Boston, about 30 miles from Boston Harbor. In addition, much of the Bank is under 100 feet of water or less, making it accessible to current U.S. offshore dredging technology. Finally, the Bank is in Federal waters, and is therefore potentially available for leasing.

The declaration of an EEZ may not have really been an impetus for ocean exploration. Instead, since it created definite boundaries on what was previously considered common ground, the EEZ may have produced a Federal interagency shoving match, with numerous agencies trying to extend their jurisdictions onto the new territory.

COMPUTER GRAPHICS ANIMATION OF SIMULATED ROOM FIRE GROWTH

by

Jan Husby
Erik Martin
Martin Mooney

An Interactive Qualify Project at WPI

Research on the behavior of room fires is part of the science of Fire Protection. One method employed in this research is the use of fire simulation models on computers. Given the characteristics of one or more rooms, these models calculate numeric values of the factors that contribute to or quantify a room fire. Presently, most fire models produce results in a form intended for the educated engineer or researcher. In most cases this is in the form of long lists of variables and their values at various stages of the simulated fire.

The main goal of this project is to make the results of a room fire simulation available to a larger audience, an audience that includes the layman who has no education or experience in the field of Fire Protection, as well as the engineer or fire science researcher.

In order to reach this goal, a program that utilizes computer graphics to animate a room fire has been designed and implemented. The program has been demonstrated to laymen and to professionals of the science. Both viewer groups have responded positively to the effort.

To the professionals, the animation program provides a compressed overview of the simulated fire. From this overview, an intuitive understanding of the fire's progression can be obtained before analyzing the details in the fire model output.

The animation program also has uses within education. To the fire protection student, an animation can ease the understanding of a room fire's dynamics.

Laymen are the animation program's largest potential audience. Laymen are the most common victims of room fires, too often with lethal results. Using the animation as a visual media, laymen can be taught the most important aspects of room fires. The program can illustrate the effect of furnishing rooms in different ways. It gives the viewer an idea of how much time he would have to escape a burning room. As the room fire simulation models become more sophisticated, the animation program can also illustrate the effect of different furniture materials in burning rooms.

APPLICATION OF STANDARDS IN THE INTEGRATED CAD/CAM ENVIRONMENT

by David T. Stewart

Washington Internship for Students of Engineering and
U. S. Air Force Academy

My research was accomplished during the period of May to August 1986. An interest in engineering and public policy, especially dealing with computer-aided design/computer-aided manufacturing (CAD/CAM), was sparked by my academic and research advisor Major Mark S. Ewing at the United States Air Force Academy.

He introduced me to the Washington Internship for Students of Engineering program. This program was oriented toward practical research on an engineering area for which there was public policy analysis being conducted on Capitol Hill. We were sponsored by engineering societies, such as The American Society of Testing and Materials, in the Washington area. This program developed into quite a project as test were completed, data analyzed, and suggestions put forth on Capitol Hill for dramatic changes in the consensus standards process for CAD/CAM systems in government and private industry. Following the explosion of the Challenger space shuttle, there was concern that standards databases for aerospace companies and other industries were insufficient or not being used properly at the CAD/CAM level. My research looks into this highly controversial area.

Rules for the 1988 National Student Projects Competition

in
Science, Technology, and Society (STS) Studies

The Society for Social Studies of Science (4S), Worcester Polytechnic Institute (WPI), and possible Student Pugwash USA are sponsoring a second Projects Competition designed to recognize exemplary project work in STS. $1000 in prize money will be awarded. The work of the winners will be recognized at the annual 4S awards banquet, and will receive further recognition in the official journal of the 4S, SCIENCE AND TECHNOLOGY STUDIES, and WPI INTERACTIONS 9.

This year, since the 4S will be meeting in Amsterdam on November 16-19, 1988, the national student competition will be held in mid-October of this year at WPI. The top prize winner will receive free airfare so that he or she can attend the 4S meeting and present the prize winning work.

DESCRIPTION:

This is an English Language Competition open to all undergraduates in American and Canadian Academic Institutions.

Any undergraduate work completed in the last three years is eligible for consideration.

Entries may be any high quality project work done as theses, independent study projects, seminar reports, term papers, or internships.

The judging, to the level of semi-finalist, will be based on a 3-5 page extended abstract, which must include the nature of the assignment that produced the paper, and acknowledge the role of a faculty advisor if one was involved.

DEADLINES:

A. Letter expressing interest due on.... July 1, 1988
B. Extended abstracts due on..... August 1, 1988
C. Request for two copies of the completed paper to be issued to semi-finalists on or before..... August 15, 1988
D. Invitations issued to Honorable Mentions to come present their work at the conference if they wish, by....September 1, 1988
E. Papers of Semi-finalists must be submitted and available for judging by .....September 5, 1988

Note That

Awards will be based 2/3 on written document submitted and 1/3 on the 20 minute oral presentation.

Letters expressing an intention to submit an abstract or requesting further information should be directed to:

Professor John Wilkes,
Chairman of the Student Project Competition Committee,
Department of Social Science and Policy Studies,
Worcester Polytechnic Institute
Worcester, MA 01609 (617) 793-5578

WPI INTERACTIVE QUALIFYING PROJECT ABSTRACTS, 1986-1987

Technology and Environment

Faculty Coordinators:

Professor R. Cheetham
Professor J. O'Shaughnessy

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NASHUA RIVER FIELD GUIDE

Students: David G. Polcari
Paul J. Anastasia
Advisor: F. L. Hart

The Nashua River was not always a place of beauty. Since 1970 efforts to clean the river have been undertaken by the Nashua River Watershed Association. One major issue now is the need for increased public awareness about the river and its inhabitants. Without the public's awareness, the river is destined to return to a state of decay. One of the best and most efficient ways of promoting awareness is a guide to the river which includes maps and information pertinent to the river. The Nashua River Field Guide is presented as a useful tool for further enrichment of the Nashua River.

Report No. 87C009I pages 50

THE MODERN ECOLOGICAL CRISIS; A SOCIAL CRITIQUE BASED ON AN IN-DEPTH STUDY

Students: Paul S. Amons
Jason Goldberg
Karen Stringer
Advisor: R. S. Gottlieb

This project examines the current environmental problems and the social institutions, practices, attitudes, and philosophical and religious perspectives which create these problems. A case study in solid waste disposal is used as an illustration of the effects of these institutions. Solutions are proposed involving changes in social structures which would allow society to harmoniously co-exist with nature.

Report No. 87C000I pages 41

LEICESTER SCHOOL NEEDS

Students: Nancy A. Clark
Russell L. Houde, Jr.
Advisor: M. S. FitzPatrick

The objective of this project has been to investigate the future school needs of Leicester, Massachusetts, and to make recommendations based on the findings. The school system is now experiencing some overcrowding. Through interaction with school staff members, analysis of the present situation, and review of building requirements from the Massachusetts Department of Education, some judgement has been made on the present adequacy of the school facilities. A demographic study has also been conducted in order to predict the number of students that can be expected in the future. With this information, the adequacy of the present school buildings for future needs has been assessed; and from this, a recommendation for future action has been formulated.

Report No. 87C019I pages 117

BERLIN, NEW HAMPSHIRE, THE ANDROSCOGGIN RIVER, AND QUALITY OF LIFE

Students: Jon S. Tilton
Advisors: J. M. Boyd
M. S. FitzPatrick
Van Bluemel
R. L. Moruzzi

This report examines the roles of the Federal Environmental Protection Agency, state and local agencies, as well as the roles of local industry, in providing a safe environment for the community, and at the same time an economic vitality. Community, economical, social and environmental aspects are covered.

Report No. 87C057I pages 52

ACID RAIN DAMAGE REPORT

Student: David G. Allen
Advisor: R. E. Wagner

The Nashua River Watershed Association proposed that a report be written assessing the vulnerability of the watershed to acid rain. The final report provided an overview of acidic deposition and discussed its effects on water chemistry, aquatic biota, vegetation, soils, materials, human health, and climate. Conclusions were drawn on the areas of the watershed which are most vulnerable to acidic damage.

Report No. 86D230I pages 175

A COMPUTER MODEL OF EAST LAKE WAUSHACUM WATERSHED

Students: Deborah Sifford
Leonidas Papadopoulos
John B. Keat
Advisor: A. H. Hoffman

The objective of this project was to develop an interactive computer program that will educate the watershed residents about the problem of eutrophication in East Lake Waushacum. The computer program asks the users certain questions to gather data about their lifestyles. The data is used to approximate their phosphorous contribution to the lake. The program then calculates and lists the sources and amounts of phosphorous that the individual is contributing to the lake. These sources include such things as sanitary wastes, laundry detergent, dishwashing detergent and fertilizer. By presenting watershed residents with their individual phosphorous contributions, they can then evaluate how changes in lifestyle would help reduce the eutrophication rate in the lake. The computer program also compares the individual user's effect and the entire watershed community's effect on the lake.

Report No. 86D29CI pages 221

WATER DISTRIBUTION SYSTEMS: A GROWING PROBLEM

Student: Theodore M. Brown
Advisor: F. L. Hart

This project reports on the various ways that potable water in distribution systems can lose its quality. An extensive literature survey resulted in a paper based on the most up to date material from experts in the field. America's water distribution systems are in trouble and a new computer model method is a possible solution. The computer model, developed at WPI, would simulate and give output of the water quality conditions throughout a distribution system. Case studies, taken from the literature, are given to demonstrate the usefulness of the model.

Report No. 86D246I pages 103

MICROBIOLOGY: WATER SUPPLY

Student: Thomas O'Keefe
Advisor: R. D. Cheetham

Population quantification of Enterbacter cloacae were carried out over a period of several days in reservoir water (1) containing Hyalella azeteca and (2) without Amphipods. Values obtained were used to establish association and dissociation rates for firmly associated bacteria.

Report No. 86D302I pages 117

DEER ISLAND AND THE BOSTON HARBOR CLEAN-UP

Students: John Lavelle
Chris Rogers
Peter Carlson
Advisor: K. Keshavan

The issue of siting a Boston Harbor wastewater treatment facility has been a growing problem for decades now. The following study examines the ten options that were originally proposed for siting the wastewater treatment plant. The engineering feasibility, costs, environmental impacts, and political considerations of four of these options were further examined using published reports, newspaper articles, and interviews with those persons involved in the decision making process.

Report No. 86D250I pages 93

WASTE METAL RECOVERY USING A PENICILLIM SP

Student: Jeffrey L. Blanchard
Advisor: R. D. Cheetham

In this project the technical feasibility of a biological system, based on penicillium ochrochloron, to remove metals from industrial waste water, was established. Some of the various environmental problems associated with metal pollution were investigated. This biological system could provide a more economical means of removing and recovering metals from waste water, alleviating a small part of the pollution that results from our dependence on industrial processes.

Report No. 86D244I pages 33

ENVIRONMENTAL ASSESSMENT OF A PROPOSED INDUSTRIAL PARK

Students: Edward R. Danek
Raymond J. Franz
Steven E. Woodard
Advisor: M. S. FitzPatrick

The problem addressed by this project was evaluating the possible environmental effects of a proposed light industrial park. The proposal was initiated by the Leicester Industrial Development Commission for a site located in the Town of Leicester, Massachusetts. The objectives of this project were to make a comprehensive environmental assessment of the site in question; to design a light industrial park best suited to existing conditions; and to evaluate the possible effects of such a development on the area. Town officials consider this site the most likely area for development and we anticipate that the result of our study will greatly aid the town of Leicester in making decisions regarding the future of the site.

Report No. 86D261I pages 110

SITING OF A HAZARDOUS WASTE FACILITY IN MASSACHUSETTS

Students: Margaret Dwyer
Rhonda Lamparelli
John A. Wright
Advisor: I. M. Young

The problem of dealing with hazardous waste has created the need for siting new and better facilities. This IQP will examine the siting process and some of the related problems in siting a facility for the state of Massachusetts. Recomendations will be made on how Massachusetts could improve its siting process.

Report No. 86D270I pages 130

A PROPOSAL FOR AN ANTARCTIC REGIME

Students: Joseph Fern
Jack Spadaro
Advisors: V. Bluemel
J. M. Boyd

The ecologically important Antarctic region contains many valuable resources, and internationalization and exploitation now appear imminent. Eighteen nations presently administer the region by the Antarctic Treaty of 1959, although alternative regimes, several analyzed herein, have been tendered. Using a set of criteria emphasizing environmental safeguards and wealth sharing, a unique regime is developed, analyzed, and compared to the alternative regimes.

Report No. 86A009I pages 125

COST OF CORROSION DUE TO ACID RAIN

Student: Denise L. Jolley
Advisor: R. D. Sisson

The procedures for the determination of the cost of corrosion due to acid deposition have been reviewed. The economic approach of an input-output analysis is discussed in detail. The results of previous work on the overall cost of corrosion are presented and discussed. The difficulties in separating those costs due only to acid deposition from general corrosion phenomena are also presented.

Report No. 86A037I pages 30

RAINDANCE

Student: Richard W. Boosey III
Advisor: H. K. Ault

A computer graphics simulation was designed to illustrate the effects of acid rain on the environment. The project, sponsored by Nashua River Watershed Association, (NRWA), was developed to help school age children in Nashua Watershed area understand the problems of acid rain.

Report No. 86B014I pages 91

PESTICIDES - AN ENVIRONMENTAL HEALTH HAZARD?

Students: Stephen W. Juhnevicz
Richard P. Marciniec
Thomas M. Payne
Daniel R. Sioui
Joseph A. Tracy
Advisors: J. M. Boyd
V. Bluemel
R. L. Moruzzi

The goal of this project was to assess the severity of the human health hazard posed by pesticides use in the Northeastern United States. The result of this study shows that there is a high probability that pesticides use poses a serious threat to human health.

Report No. 87D018I pages 98

THE COST OF CORROSION DUE TO ACID RAIN

Students: David S. Lamont
Brian J. Smith
Advisor: R. D. Sisson

The cost of the degradation due to acid deposition of WPI's Founders Hall was calculated using a damage function methodology. This cost estimation technique calculates both the maintenance and material replacement costs. The estimated cost to WPI's Founders Hall for 1986 was only $188. However, the estimated cost in 1986 dollars for 1999 is $2,500 and for 2026 is approximately $6,000. An extension of this damage function methodology to the entire WPI campus shows estimated costs to WPI for corrosion due to acid deposition in excess of $100,000 per year in the near future.

Report No. 87D021I pages 53

THE COST OF CORROSION DUE TO ACID RAIN

Students: George E. Dalkouras
Daniel J. Field
Brian DeFlumeri
Advisor: R. D. Sisson

Acid deposition can cause the degradation of building materials including metals, paint and cement, as well as the natural environment. The EPA has attempted to develop procedures and techniques to determine the cost of corrosion due to acid deposition. In this report, the EPA's methods for calculating these costs is discussed in terms of the required input data and accuracy of the estimate. In addition a proposed plausable method for accurately calculating these costs is presented.

Report No 87D158I pages 90

HAZARDOUS WASTE MANAGEMENT IN MASSACHUSETTS

Students: Paul J. Keating
John G. Tzimorangas
Advisor: R. D. Cheetham

In recent times, the world has experienced rapid growth in technology. The wastes from this industrial boom have become a growing and very serious problem in modern society. What companies do with these wastes is a complicated as well as intricate question. This project was designed to assess whether there is a problem with heavy metals contamination in Central Massachusetts. It consisted of interviewing companies in the private sector that deal with this problem.

Report No. 87D235I pages 114

AN OVERVIEW OF LEGISLATION DEALING WITH RADIATION EXPOSURE

Student: Richard F. Sheahan
Advisor: D. W. Woods

This IQP deals with the current legislation which provides compensation for those exposed to radiation. The three types of legislation to be discussed are the Atomic Energy Act of 1954, worker's compensation laws and Massachusetts' state law as an example of the individual state statutes. The ways that these laws interact and how they could be improved will also be discussed.

Report No. 87D038I pages 47

WHY DO SOME RESOURCE RECOVERY PROJECTS FAIL?

Student: Arthur Del Savio
Advisor: T. C. Crusberg

The goal of this project was to answer the question: why do some resource recovery projects fail? By analyzing two different resource recovery projects, one which failed and one which succeeded, the student showed how the lack of a successful public participation program can lead to the failure of such a project.

Report No. 87D014I pages 60

CATEGORY II INSTRUMENT LANDING AT WORCESTER MUNICIPAL AIRPORT

Student: Stephen P. Oleksak
Advisor: R. D. Desrosiers

This IQP analyzed the impact of establishing a Category II Instrument Landing System at Worcester Municipal Airport. With the use of Federal Aviation Administration documents and other data sources, the technology and economic impacts of the "CAT II" were discussed. Airport weather and flight cancellation records were examined and a recommendation was made in terms of cost versus benefits for or against the installation of the Category II I.L.S. It was concluded that, given the present business climate and rate of area growth, a Category II ILS should be installed within five years.

Report No. 87D281I pages 97

REGULATION OF CADMIUM IN WATER

Student: Wendell Brent Mah
Advisors: J. M. Boyd
V. Bluemel
R. L. Moruzzi

In 1980, an estimated sixty metric tons of cadmium per year was dumped into the Hudson-Raritan Basin. Cadmium is known to be extremely toxic to humans if ingested, yet at present a suitable industrial substitute for cadmium is not available. This project deals with the regulation of cadmium pollution in water. This report investigates whether or not the laws presently governing the discharge of cadmium are stringent enough to protect human beings from harm.

Report No. 87D259I pages 46

SOLID WASTE MANAGEMENT: INCINERATION VS LANDFILL

Students: Stephen E. Shiller
Joanne M. Couture
Advisor: J. M. Boyd
R. L. Moruzzi
V. Bluemel

The goal of this project is to conduct a critical assessment of the different types of incineration methods of Municipal Solid Waste versus landfill methods. Applying the results of this critical assessment, the best method of dealing with municipal solid wastes for the region of Central Massachusetts was determined.

Report No. 87D147I pages 153

ACID DEPOSITION AND ITS EFFECTS ON MATERIALS

Students: Alan Randmae
Cheryl A. Weston
Advisor: R. D. Cheetham

This report studied the damage acid rain causes to materials. Samples of common materials subject to our laboratory simulated acid rain showed significant weight loss and surface damage. We developed and administered two questionnaires which reveled that the general public is aware of this problem but that they are not too concerned. The experts are both aware and concerned. Because of the complexity of this problem, the general public must become concerned before significant progress can be made.

Report No. 87D276I pages 78

ENZYMATIC DEGRADATION OF CELLULOSIC WASTE

Student: Rawl J. Rutter
Advisor: J. C. Bagshaw

In recent years, society has started to realize the need for new waste disposal methods because of the decreasing space for landfilling and the increasing demand for a cleaner environment. Since most of municipal waste is comprised of cellulosic material, disposing of municipal waste must also deal with the disposal of cellulose in the waste. The problems of cellulosic waste disposal can be solved by use of enzymatic degradation. In this process, cellulases are collected and used to convert cellulose to glucose. In addition, this glucose can be converted to ethanol.

Report No. 87D303I pages 55

THE ENVIRONMENTAL IMPACT OF RESOURCE RECOVERY

Student: Douglas L. Smith
Advisor: T.C. Crusberg

The project consisted of a literature search for information on environmental impact of emissions from solid waste resource recovery systems, as well as the best available emissions control technologies. Emphasis was placed on air emissions, notably acids, heavy metals, particulates and especially dioxins. Emissions testing was found to be one of the most important problems because it is difficult and expensive, but with new pollution control equipment now available resource recovery is the only option for refuse disposal available.

Report No. 87D316I pages 48

INTERGOVERNMENTAL COORDINATION OF INFRASTRUCTURE RESEARCH ACTIVITY

Students: John M. Garvin
Kathleen M. Sherry
Mark R. Tsombakos
Advisors: R. Long
L. E. Wimmergren

The nation's infrastructure is showing the effects of aging, excessive use, and obsolescence. The inability to address the nation's infrastructure needs adequately constitutes a major problem that seriously threatens our physical and economic wellbeing. In order to accomplish the extensive rehabilitation of the infrastructure, coordination, cooperation, and communication must exist among the various agencies involved. This report, which was prepared for the National Science Foundation, examines the methods of technology transfer among the various levels of government.

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THE ALBERT HENRY MIDGLEY COLLECTION

Students: David A. Burrage
Henry J. Clark
Michelle A. Pence
Advisor: J. F. Zeugner

This project, performed for the Archives Department of the Institution of Electrical Engineers in London, involved generating a list of the contents of the Albert Henry Midgley Collection, designing a computerized system to catalogue the collection, and compiling a preliminary analytical biography of Albert Henry Midgley. The Collection consists of a great number of records concerning Midgley's inventions and businesses. An understanding of computerized archival techniques and of British social, economic and industrial history was required to complete the project.

pages 199

ELECTRICAL ENGINEERING MANPOWER PROJECTIONS FOR THE UNITED KINGDOM

Students: Karen Desrosiers
John Powers
Mark Wartski
Advisor: J. F. Zeugner

This report, prepared for the Institution of Electrical Engineers, deals with the topic of critical manpower availability in the electrical engineering sector of the United Kingdom. With IEE annual salary surveys as a database, the project team performed projections utilizing multiple regression analysis with various indicies which were indicative of the future supply of electrical engineers. Recommendations were made to the IEE dealing with the survey and ideas for the United Kingdom Government to improve the supply and skills of its electrical engineers.

pages 204

RESTRUCTURING THE WORSHIPFUL COMPANY OF SCIENTIFIC INSTRUMENT MAKER'S ANNUAL ACHIEVEMENT AWARD

Students: Paul R. Mancini
Jodi-Ann Medeiros
William F. Noel
Advisor: J. F. Zeugner

This report, prepared at the London Project Center, creates a formal methodology and selection system to be used for the Worshipful company of Scientific Instrument Makers' Achievement Award, given annually for the best commercially innovative techical instrument. The project identifies new sources (e.g., The Design Centre, trade shows, periodicals) for finding award applicants. Additionally, the project generates a formal application (none had previously existed), makes suggestions on improving award publicity as well as a preliminary recommendation for the 1987 award winner.

pages 137

EVALUATION OF THE RESULTS OF EPO AND UNITED KINGDOM PATENT OFFICE SEARCHES FROM THE USERS' POINT OF VIEW

Students: Sergio Levi
Robert Petrin
Andrew Scholand
Advisor: J. F. Zeugner

This report, completed in London for the United Kingdom Patent Office, examines user's satisfaction and perceived weaknesses with the patent search process. The analysis is based on extensive personal interviews conducted in London and The Hague which asked patent agents to compare the higher standard European Patent Office search with the UKPO's. Recommendations made to the agency differed from current policy proposals and centered about the unexpected user satisfaction with the price/quality balance of the UIPO search.

pages 540

Energy and Resources

Faculty Coordinators:

Professor E. Clarke
Professor D. Woods

DIV42

PV PROMOTION FOR RURAL ELECTRIFICATION

Students: Visarut Asvaraksh
Aswin Pinsuvana
Advisor: E. N. Clarke

The main accomplishment of this research is a detailed description of a generic method of promoting PV for rural electrification. This generic method is a result of studying two different models of PV promotion. One is the approach of promoting PV for rural villages of a developing nation by Rich Hansen, and the other is the approach of promoting PV for remote homes in a developed nation by Jeff Fowler. In addition, a village in Thailand was chosen as a demonstration for this generic method. This report contains information on Thailand and Indonesia.

Report No. 87C010I pages 170

OIL PRICES AND COAL CONVERSION

Students: Marc Moran
Peter E. Nordquist
Raymond Labbe
Advisor: D. W. Woods

The purpose of this project is to determine the economic feasibility of converting New England electric generating plants from oil to coal.

Report No. 87C054I pages 410

ANALYSIS OF THE LICENSING PROCEDURE FOR NUCLEAR PLANTS

Student: Timothy R. O'Toole
Advisors: J. M. Boyd
Van Bluemel
R. L. Moruzzi

This report analyzes the licensing procedures for nuclear power plants in the United States as it pertains to the assurance of safety. As a standard for comparison, the goals drafted by the Nuclear Regulatory Commission, in its policy statement regarding guidelines for safety, are used. These goals are then used to develop specific criteria which are then used to evaluate the procedures involved in the licensing process.

Report No. 87C058I pages 79

A CRITICAL REVIEW OF PHOTOVOLTAIC SYSTEM COST

Students: Bryan C. Widmer
Timothy P. Richer
Jeffery J. Enos
Advisor: E. N. Clarke

This report assessed the economic viability of photovoltaics. Working with the current literature and by interviewing industry experts, we examined various solar cell manufacturing techniques, the balance of system costs, and the effects of mass production on individual component costs. Our project concludes that photovoltaics are becoming economically competitive with other methods of generating electricity.

Report No. 87C025I pages 317

APPROPRIATE TECHNOLOGY: ENERGY SELF-SUFFICIENCY

Students: Gopal D. Amin
Stuart Zysman
Advisor: P. P. Dunn

This project report examines the economic, social, and political conditions in the Third World nations before, during, and after colonialism. It then describes the nature of Appropriate Technology, a revolutionary approach to implementing technology in rural areas of Developing Nations. The final section is a case study of a village in India, actually visited by the authors, where AT is being applied to make a village self-sufficient in food and energy.

Report No. 86D231I pages 90

APPROPRIATE TECHNOLOGY: A PEDAL-POWERED GENERATOR

Students: Philip J. Resca
Brian F. King
Lee Fredette
Scott N. Coulter
David J. Buzzeo
Advisor: P. P. Dunn

After spending a term studying the problems of and obstacles to development in the Third World, this student group designed, built, and tested an inexpensive pedal-powered generator, with workbench assembly. The goal was to combine light work, e.g. seed sorting, with pedalling that provided the mechanical energy to work an alternator. It was found, however, that the effort required to run the alternator was so great as to preclude any simultaneous activity.

Report No. 86D248I pages 100

EFFICIENT USE OF WOOD STOVES

Student: Francis J. Weber, Jr.
Advisor: R. R. Borden

This document discusses how to use a wood burning stove efficiently. The report contains discussions on how to prepare wood for use in the stove, problems encountered with the use of a wood stove, and the relative efficiencies of several types of stoves. From this report one may determine if a switch to a wood based heating system is a viable alternative.

Report No. 86D315I pages 47

APPROPRIATE TECHNOLOGY: CHINESE CHAIN PUMP

Students: Amabel Yee
Donald Seeto
Advisor: P. P. Dunn

After spending a term studying the problems of and obstacles to development in the Third World, this student group designed, built, and tested an inexpensive handpump using a crank and chain. A discussion of the Third World development and the design of the waterpump are included in the report.

Report No. 86D308I pages 93

THE SOLAR TRAIN: PHOTOVOLTAICS EDUCATION

Students: Jay T. Niland
Chris Coulter
James T. Ide
Advisor: E. N. Clarke

In our society, there is a need for an increased awareness of energy conservation and alternative energy sources. Energy from the sun, generated by the photovoltaic cell, is a viable alternative in many applications. Through an exhibit at the Worcester Science Center, we can demonstrate solar technology and its applications. By the design and implementation of a solar passenger train, we hope to educate the public concerning solar powered transportation.

Report No. 86D257I pages 100

LOAD MANAGEMENT STUDY FOR THE TOWN OF WELLESLEY

Student: Kevin J. McNeely
Advisor: H. Majmudar

This project was a study of the application of load management techniques for use by the town of Wellesley Department of Public Works. Methods of peak shaving by direct and indirect control techniques are discussed, and some of these have been implemented. This study will also aid the D.P.W. in the decision to develop a direct control load management pilot project.

Report No. 86D300I pages 60

BELMONT HOME ENERGY STUDY

Students: Andrew Gathy
Robert K. Gildea
David Hargreaves
Advisor: T. Hammond

This IQP investigates the domestic hot water system of the Belmont Nursing Home. This investigation was based on three phases of analysis. The first phase examines the existing domestic hot water system defining its thermal characteristics. This phase was followed by an analysis of cost effective modifications to improve the system's thermal efficiency. The final phase examined alternate sources of thermal energy. The result was a set of written recommendations.

Report No. 86D276I pages 44

PV-WIND ENERGY FOR PUERTO RICO

Students: Carlos Gutierrez
Miguel Marxuach
Advisor: E. N. Clarke

This project examines the past, present, and future of alternate sources of energy in Puerto Rico and investigates two alternate energy projects on the U.S. mainland. These tasks were complemented by door-to-door surveys of people in three urban areas involved in alternate energy projects. The project team's objective was to present, understand and evaluate the status of alternate sources of energy in Puerto Rico. The project team also developed an understanding of alternate energy sources in Massachusetts.

Report No. 86A035I pages 348

FEASIBILITY STUDY FOR ZEALAND HYDRO

Students: William F. Giard
Stephen M. Hunt
Advisor: R. R. Borden

Alternative energy techniques have important applications in many areas of our society. The Appalachian Mountain Club's hydroelectric system at Zealand Falls, NH, has encountered many problems in its remote setting. In this report, we have addressed the problems and suggested alternative methods/configurations for the hydro system.

Report No. 86B057I pages 74

DESIGN OF A GEO-SOLAR HOME

Student: David B. King
Advisor: L. E. Wimmergren

In this IQP a house was designed in such a manner as to provide pleasing aesthetics and establishing a residence which would be as free from conventional heating methods as possible. The intent of this project was to provide a complete theoretical fabrication of a geo-solar home. The report covered the active and passive heating system, heat storage, heat distribution, construction materials and floor plans. Ultimately the home constructed is sixty percent underground with sufficient natural light and ninety-eight point five percent of its heating needs provided by solar means.

Report No. 86B023I pages 130

THE FUTURE OF PHOTOVOLTAIC CELLS

Student: Gerald G. Melesko
Advisor: D. W. Woods

This report deals with electricity generated by photovoltaic cells as an alternative to oil and electricity. The execution of this project involved a study of the most recent development of photovoltaic cells as a substitute for utility electricity. An analysis of the impact of forecasted electricity prices on the development of photovoltaics is conducted to determine if and when PV's will become economically feasible as an alternative form of energy.

Report No. 86B064I pages 62

CENTRAL RECEIVER SOLAR THERMAL POWER PLANTS: AN EVALUATION

Student: Stephen A. Squadrito
Advisor: D. W. Woods

Since the oil energy crisis in the mid-seventies, many alternative means of electricity generation have been devised. One such technology is Central-Receiver Solar Thermal Power Plants. This project studied the economic and political implications to determine whether central-receiver plants can be a significant contributor to United States electricity needs of the future.

Report No. 86B071I pages 46

FEDERAL PETROLEUM TAXATION

Students: Dana Barnes
John Edman
Ronald Gaudet
Advisor: D. W. Woods

This report examines federal petroleum taxes in the United States. The report initiates the examination with a historic overview of domestic petroleum taxation, and continues with a discussion of the uses of federal petroleum taxes. The primary recipient of this taxation is the Interstate Highway System. Basic microeconomic theory of taxation is then detailed along with current federal opinions and recommendations concerning federal petroleum taxation. Next, the report reviews the current feasibility of additional petroleum taxation. Finally, the report concludes that an excise tax used to lower income taxes would be the most prudent petroleum tax that the federal govenment could implement.

Report No. 87D004I pages 93

SOLAR PHOTOVOLTAICS FOR REMOTE HOMES IN NEW ENGLAND

Students: Paul W. Shaw
Vince Matrisciano
Joshua Stockdale
Advisor: E. N. Clarke

This IQP report describes the use of solar photovoltaics in remote homes in New England. We describe the nature of photovoltaics, and its use in remote homes, and the people who make up the PV industry in New England. We assess the suitability of photovoltaics for remote home applications, and the outlook for PV use in the future. There are a suprisingly large number of PV powered remote homes in New England (about nine hundred homes).

Report No. 87D028I pages 193

SOLAR PV INTERACTIVE EDUCATION: SCIENCE CENTER

Students: Curtis Clark
Tom Goon
John Mileski
Mark O'Brien
James Beals
Advisor: E. N. Clarke

The project consisted of the design and construction of an interactive exhibit at the New England Science Center. A main concern of this project is to increase public awareness of photovoltaics (PV). The exhibit was based on an analogy between the solar tracking abilities of sunflowers and photovoltaic arrays. The visitor will be able to relate a seemingly complex technological concept to a common natural occurrence.

Report No. 87D129I pages 117

PHOTOVOLTAICS FOR CONSUMERS

Students: Daniel W. Chancey
Philip J. Pelletier
Advisor: E. N. Clarke

This is a study of the photovoltaic consumer industry, the use of PV in consumer products, the marketing of these products, and its future. A study of marketing new consumer products and various interviews and surveys with people in the PV industry, retailers and consumers has been conducted. The PV consumer project industry is just beginning. Products such as the PV hand-held calculator have been extremely successful, but other PV products are just entering the market. By looking at the present state and potential PV use in consumer products and interviews with retailer and consumers, a generalized hypothesis of the future of consumer product success is described.

Report No. 87D128I pages 119

SOLAR PHOTOVOLTAIC OUTDOOR LIGHTING

Student: Francis J. Donino
Advisor: E. N. Clarke

In the wake of concern for alternative energy sources, this report explores Photovoltaics as a solution to problems often associated with the applications of conventional lighting systems. The report approaches sites on the Worcester Polytechnic Institute Campus that have installation obstacles (usually costs) that make conventional lighting systems impractical. In addition, a statement is made about the educational aspects that Photovoltaic lighting can provide to the students and community.

Report No. 87D168I pages 154

LIGHT BULB SAVERS

Student: Mark Miller
Advisor: A. E. Emanuel

This project dealt with the study of in-socket light bulb saving devices, specifically a device called "The Cup". The report covers a sample survey done on public awareness and attitudes towards the device, light output and life tests, the safety of such a device, and an economic evaluation of long term usage. Upon completion of analyzing these aspects of the device, conclusions were drawn as to the overall usefulness of this device to society.

Report No. 87D242I pages 69

Health Care and Technology

Faculty Coordinators:
Professor J. O'Connor
Professor R. Peura

DIV 43

PROJECT BODY WORKS

Students: Karen Reichenbach
Carleen Maitland
Natalie A. Lucas
Advisor: L. Goodwin

This research team, consisting of Worcester Polytechnic Institute and Worcester State College students, tested a prototype videodisc system titled, BODY WORKS, on adolescent patients of Saint Vincent Hospital's pediatric ward. The videodisc system was evaluated for educational and stress relief value through testing materials which were developed from background research and results from a trial questionnaire used to test adolescents' hospital attitudes. The developed testing materials were then used while adolescent patients made use of the BODY WORKS videodisc system.

Report No. 87C038I pages 173

THE MEDICAL MALPRACTICE CRISIS

Students: William R. Hill
Peter J. Michhelson
Kathie B. Schaeberle
Ann F. Palmer
Advisor: M. D. Halsey

This project examines the medical malpractice crisis. Research was conducted through surveying the literature as well as interviewing Massachusetts professionals in both the medical and legal professions. It was concluded that the crisis is a direct result of the actions of the insurance industry in its attempts to protect itself from potential liabilities. The general public bears the brunt of the crisis since the crisis has affected the quality and availability of patient care.

Report No. 87C053I pages 95

ETHICS IN GENETICS

Student: Jon A. Pollard
Advisor: T. A. Shannon

This project reviewed the development of the technology of recombinant DNA and its implications for gene therapy and genetic engineering. Then the author traced the rise of regulations of that technology from the community of scientists and the Federal Government. Finally, a survey of attitudes and information of WPI and Clark students about these issues and their relation to genetic engineering is presented.

Report No. 87C045I pages 62

PHYSICAL PAIN MANAGEMENT

Students: John J. West Jr.
Scott D. Gallett
Willard H. III
Advisor: D. G. Gibson III

The effects of dietary l-tryptophan supplements on pain tolerance and sensitivity and on mood assessed in a controlled, blind study on eleven members of the WPI men's crew during training. Eight of the eleven did perform better with L-tryptophan than with a placebo, but significant over controls at ninety-five percent confidence was seldom observed. Two other crew members attempted mental management of pain via meditation techniques, with equivocal results.

Report No. 87C025I pages 113

BIO-ETHICS OF SYNTHETIC HUMAN GROWTH HORMONE

Students: David P. Arcidiacono
Glen G. Bernard
Robert A. Cupolo
Mark S. Guitarini
John M. Smith
Advisor: R. L. Smith

This project addresses the technological, social, and ethical aspects of the development and use of synthetic human grown hormone. The authors give particular attention to two problems: that of the small audience (dwarves) initially targeted for the use of HGH yet the industry's need for a larger profit and that of the use and abuse of this hormone by others, particularly athletics.

Report No. 87C054I pages 43

STRESS MANAGEMENT

Student: Michael B. Mahler
Advisor: F. Green

This report discusses stress effects in the computer programming environment, and the history of stress recognition and its place in the modern engineering environment.

Report No. 86D296I pages 43

MASSACHUSETTS BIOTECHNOLOGY RESEARCH PARK

Students: Peter J. Paglia
Vincent J. Giordano
Anthony B. Rosatone
Advisor: K. P. Ruscio

In 1982, Worcester proposed the development of a biotechnology research park. According to the initial projections, the park would greatly contribute to the local economy. But numerous delays raised doubts about the park's success. This IQP examines the impact of the delays. It concludes that the park might not fulfill its promise. During the course of these delays, the biotechnology industry changed rapidly and in such a way that the Park might have missed some opportunities.

Report No. 86D278I pages 74

BMET PHYSIOLOGY COURSE

Student: James S. Marsan
Advisor: D. G. Gibson

This project involves writing and evaluating a manual designed to teach kidney anatomy and physiology to bio-medical engineering technicians. It is necessary that the BMET's be aware of kidney physiology since one of the machines for which they are responsible is the kidney dialysis machine. Each section has a self-quiz to check the technician's understanding of the material. Answers and explanations are provided at the end of the manual. There is also a section which compares the function of a healthy kidney to the artificial kidney.

Report No. 86D319I pages 53

A NEW REIMBURSEMENT SYSTEM FOR MEDICARE

Students: Steven R. Andree
William S. Hughes
William M. Mansfield
Joseph Mielinski
Michele L. Miles
Advisor: R. Y. Lui

The project describes the reasons why health care costs in America skyrocked in recent years which led the government to institute a Prospective Payment System for Medicare in 1983. Effects of such a law on local hospitals are also examined.

Report No. 86D234I pages 129

ORGAN TRANSPLANTATION

Students: Robert E. McDonough
Chris A. Kaprielian
John P. Gillis
Advisor: J. T. O'Connor

This project investigates the various types of organ donor systems for the liver, kidney, and heart. It examines: the processes of obtaining donors; the network systems and distribution of the obtained organs, and the processes of choosing patients. All of the systems contained within each of the three categories are examined in terms of their availability, utilization, effectiveness, and cost. The good and bad points of each system are shown and suggestions for improvements, changes or combinations of different systems are discussed.

Report No. 86D277I pages 178

MICROWAVE EMISSIONS IN WAYLAND: A CASE STUDY

Student: Wallace L. Kurtz, Jr.
Advisor: K. P. Ruscio

In 1978, Raytheon Equipment Division applied for permission to install a radar test system on its property, but questions were raised about the potential health hazards of microwave emissions. The ensuing controversy between the Town of Wayland and Raytheon offers an illustration of how a Town responds to a perceived technological threat. It also illustrates how such local technical controversies are resolved.

Report No. 86D292I pages 48

POTENTIAL DOMAINS FOR MEDICAL EXPERT SYSTEMS

Student: Luke P. Immes
Advisor: J. A. Soetens

This project evaluates the commercial feasibility of potential domains for medical expert systems. A number of medical practitioners associated with Worcester, Massachusetts hospitals were interviewed and the benefits of expert diagnostic systems were discussed with them. Emergency room medicine - specifically chest and abdominal pain - was found to be a potentially rewarding domain for a medical expert system. Other domains of interest were neurology and acid/base disorders. From the interviews, inferences are made relative to product design and validation.

Report No. 86D285I pages 75

METHODS FOR FURTHERING PATIENT EDUCATION AT SFGH

Students: Debra A. Desrochers
Karen E. Coumou
Lisa Marie Anderson
Advisor: H. G. Vassallo

Each of the projects undertaken at SFGH incorporated some aspect of furthering patient education. The first edition of "Patient Education Classes", a guide to classes at the hospital and affiliated clinics, has been completed, as well as its accompanying Calendar of Events. The child safety project is nearly wrapped up with the installation of safety devices in three health centers; and the management engineering study of the ambulatory system at SFGH's Women's Health Center has also been successfully completed.

Report No. 86D233I pages 278

ANALYSIS OF STRESS

Student: Maria Rodriguez
Advisor: R. S. Gottlieb

This IQP examines stress from a spiritual point of view. It discusses and analyzes the main aspects of society and explores man's relation with them to show the lack of spirituality today. The project reaches the conclusion that stress is a response to this lack.

Report No. 86D318I pages 35

THE USE OF ANIMALS IN RESEARCH AND EXPERIMENTATION

Students: Scott A. Thompson
Michael F. Vazza
Advisor: R. S. Gottlieb

This project explores the use of animals in research and experimentation, from proresearch and antivisection points of view. Topics covered include medical and military research, commercial testing, funding, laws and alternatives. The paper concludes with the opinions of the authors.

Report No. 86D298I pages 147

PRODUCT LIABILITY IN THE PHARMACEUTICAL INDUSTRY

Students: Robert P. McGuirk
John E. Phelps Jr.
Advisor: H. G. Vassallo

This project addresses the issue of Bendectin, a drug used to combat nausea and vomiting in pregnant women. The paper centers around the ligitations involving Bendectin and numerous birth defects. It was the purpose of this study to determine Bendectin's implication in connection with fetal abnormalities. By collecting and analyzing data in a tabular format, we were able to determine that there is insufficient evidence to implicate Bendectine in an increase in the risk of birth defects.

Report No. 86A052I pages 215

ALTERNATIVES TO HEMODIALYSIS/BMET TRAINING COURSE

Student: Jeffrey F. Brokob
Advisor: D. G. Gibson III

This project is a companion piece to an earlier BMET training guide by James Marsan, in which normal kidney physiology, the principles of dialysis therapy, and the specific operation of the hemodialysis machines used by St. Vincent's Hospital were explained. This project describes other methods of cleansing the blood in cases of kidney failure or insufficiency. Topics discussed include the use of the patient's peritoneum as a dialysis membrane, hemofiltration, isolated ultrafiltration, sorbent system dialysis, and kidney transplants. The advantages and drawbacks of each are discussed.

Report No. 86A020I pages 29

AN EVALUATION OF ISOLATION CLEANING PROCEDURES

Student: Timothy Sarr
Advisor: R. D. Cheetham

A study was undertaken at the University of Massachusetts Medical Center to determine whether spending additional funds on special isolation room cleaning procedures could be experimentally justified. While there appeared to be no significant differences in the total microbial counts obtained at five sites in a set of isolation and non-isolation rooms, known nosocomial pathogens were isolated from isolation rooms but not from non-isolation rooms. Thus, the additional costs appear to be justified.

Report No. 86B005I pages 56

PARKING PROBLEM & SOLUTION, INTRODUCTION TO IQP AT SAN FRANCISCO GENERAL HOSPITAL

Students: Michael A. Deprez
Steven F. Rowell
Advisor: H. G. Vassallo

The project involved reassessing the parking problems facing SFGH and presenting a set of solutions with which to combat them with. Our conclusions were presented to those hospital officials who we dealt with and to those whom we thought would benefit from our work. While reviewing old San Francisco General Hospital IQP's prior to our trip it became obvious that the preparation given to the IQP at WPI was not mirrored at SFGH. In order to better aclimate the student to his or her SFGH surroundings we prepared "An Introduction to the Interactive Qualifying Project at SFGH."

Report No. 86B078I pages 156

THE EFFECTS OF TECHNOLOGY ON ELDERLY HEALTH CARE

Students: Brian J. Teague
Susan A. Lindgerg
Lynn A. Burlingame
Advisors: R. A. Peura
Y. Mendelson

The cost of health care is increasing greatly, to a large extent due to the rapidly increasing elderly population, which experiences a higher incidence of chronic health problems. This project investigates various technical and non-technical services available which enable an elderly person to care for himself at home. Several examples of services that increase an elder's ability to care for himself at home, rather than in a nursing home - a more costly and less appealing alternative - were found through this project.

Report No. 86B082I pages 93

A TIME-MOTION STUDY AT SAN FRANCISCO GENERAL

Students: Edward L. Lefferts
Katrina A. Kleber
Advisor: H. G. Vassallo

In fulfillment of the Interactive Qualifying Project, we elected to work at the San Francisco General Hospital where we researched, designed and implemented a time-motion study on the nursing documentation system currently in use. Specifically, our project was needed in order to determine how much time nurses spend documenting patient care using the current system. In turn, this time was translated to salary dollars for a cost comparison to determine the feasibility of introducing revisions to the existing documenting system.

Report No. 86B079I pages 152

ACUITY TOOL STUDY IN SURGICAL OUTPATIENT CLINICS

Students: Sharon E. Biasin
Lynne M. Giere
Advisor: H. G. Vassallo

Through the use of management engineering methods San Francisco General Hospital has started to take actions to reexamine and reallocate its staffing and funds to achieve hospital efficiency. We have helped SFGH come closer to this goal through the formulation of a methodology for a unique and informal time motion study. We worked in two surgical outpatient clinics where we implemented this acuity tool study and oriented the staff to the study's process.

Report No. 86B080I pages 124

TECHNOLOGY FOR SPORTS INJURY PREVENTION AND REHABILITATION

Students: David Stuart Ure
Edward M. Jordon
Advisor: J. T. O'Connor

The goal of this project has been to present a guide to the use of technology in preventing sports injuries--and in the rehabilitation of victims of such injuries--and to evaluate the technology available in the Worcester area. The project contains a background on human physiology and common sports-related injuries. The results section presents a description of the relevant technologies and of Worcester area fitness and rehabilitation centers. Effectiveness, availability and cost information on the equipment and centers is also provided.

Report No. 87D231I pages 224

DEHYDRATION AND HEALTH

Students: Robin C. Dzialo
Barbara O'Donnell
Advisor: D. G. Gibson

Many people have become preoccupied with being thin. A trim fit individual is usually very healthy. This is not so when the body is depleted of essential minerals and fluids in order to attain this shape. Dehydration is a method used by many people to attain a thin shape. When used in moderation, dehydration can be healthy; otherwise it is very harmful to the body.

Report No. 87D178I pages 58

GOVERNMENTAL POLICIES AND BRITAIN'S NATIONAL HEALTH SERVICE

Students: Thomas Peterson
Michael Visintainer
Advisor: J. T. O'Connor

The project's objective is to report on methods used by the British government to alleviate the financial burden on its National Health Service (NHS). The project focuses on a new management approach, the Griffiths system, and the government's encouragement of the growth of private health care. Through interviews and library research the above topics were researched. The project concludes that the strain on the NHS will be reduced if administrators and consultants start cooperating and if private health care continues to increase.

Report No. 87D292I pages 146

APPEARANCE OF NEW DISEASES IN THE UNITED STATES

Student: Mia B. Angell
Advisor: T. C. Crusberg

The goal of this project was to investigate the various new diseases which have appeared during the late 1970s and 1980s in the U.S. In general the student found that these diseases (Legionella, Toxic Shock Syndrome, delta hepatitis and AIDS) were not new but had probably existed for many years, becoming noticible only when the numbers of cases increased due to technological and cultural changes.

Report No. 87D236I pages 17

HUMAN FACTORS EFFECTS OF WEARING A LVAD BATTERY PACK

Students: Gary E. Lippert
Edith M. Mickey
Philip A. Kestin
Advisor: R. A. Peura

The purpose of this IQP was to develop a study that will examine the effects of wearing a LVAD battery pack. In addition, a pilot study was conducted to evaluate three battery pack designs and reveal hidden flaws of the actual study.

Report No. 87D238I pages 76

IMPLEMENTATION AND ANALYSIS OF ACUITY STUDY AT SAN FRANCISCO GENERAL HOSPITAL

Students: Pamela Culbreth
Adele Simard
Maria Carvaial
Advisor: H. G. Vassallo

"Implementation and Analysis of an Acuity Study in Outpatient Clinics at SFGH" monitors outpatient personnel by creating an accurate record of the activities of all employees working in SFGH outpatient departments. It conducts a time and motion study, analyzes it and proposes better ways to conduct and analyze such studies. As the first step in detecting the weaknesses in the anbulatory care systems of SFGH, it indicates where preliminary steps can be taken to improve productivity and increase hospital effectiveness.

Report No. 87D239I pages 262

CARDIOVASCULAR PERSONAL EMERGENCY RESPONSE SYSTEM

Students: Joseph M. Leahy
Stephen S. Trotta
Craig A. Giglio
Advisor: R. A. Peura

This project determines the feasibility of integrating a cardiovascular telemetric monitoring device with current Personal Emergency Response Systems (PERS). The integrated system enables the frail elderly to remain safe in the home environment. The need for such a device is derived from the increase in the elderly population, and the rapid rise in health care costs. Final conclusions are based on the size and weight of the monitor as well as the overall cost of the system.

Report No. 87D237I pages 106

DEVELOPMENT, REGLATION, AND MARKETING OF NEW DRUGS IN THE U.S. AND U.K.

Student: Karyn Ann VandeMark
Advisor: L. Schachterle

The IQP compares the development, regulation, and marketing of new drugs in the U.S. and England. The different responsibilities of drug companies were analyzed through interviews and an extensive comparison of when new drugs were marketed. Testing policies were compared and government policies examined. The report concluded that a drug-lag existed in the U.S. because of American regulatory policies.

Report No. 87D342I pages 175

HEAT THERAPY

Student: Rita Marie Buckley
Advisor: D. G. Gibson III

The purpose of this study was to develop a better device for the application of superficial heat to arthritic joints and to musculoskeletal injuries. Existing therapies were surveyed, both in medical literature and by way of questionnaires to rheumatologists and orthopedic surgeons. The appliance developed was a paraffin-filled plastic jacket that could be wrapped around hands and other joints after the wax inside had been melted. This appliance conforms to almost any shape and provides lasting heat at the preferred temperature. Prototypes can be seen by contacting Dr. Daniel Gibson, Department of Biology/Biotechnology.

Report No. 87D338I pages 38

Regional Studies and Planning

Faculty Coordinator:
Professor F. Hart

DIV 44

AN ANALYSIS OF HIGH COST OF HOUSING

Student: David Delollis
Advisor: L. E. Wimmergren

This IQP examines the cost of the American Dream, the average family owning its own home. In addition, this IQP analyzes the evolution of this Dream and how it has increased in cost in recent years. This IQP also examines other costs associated with buying a house and how these costs in addition to the rising cost of an average house have contributed to preventing the average family from purchasing a home. This IQP will also present not only common ways of obtaining a home but also alternative ways.

Report No. 86D266I pages 74

TRIP GENERATION

Students: Mark J. May
Geoffrey J. Howie
Advisor: R. D. Desrosiers

The project involves study and analysis of traffic flow in and out of the parking areas of four Worcester area museums. Counts are analyzed with respect to square footage, acreage, and number of employees at each museum to give generalizing conclusions for all museums.

Report No. 86D282I pages 44

RAILS TO TRAILS

Students: Gregory R. Johnson
Timothy J. Daisy
Advisor: H. W. Hilsinger

An abandoned railroad right-of-way from Manchester N.H. to Newfields, N.H. is a recreational resource that must be brought to the attention of the State and local governments. Gathering information about multi-purpose trails converted from right-of-ways throughout the country has resulted in an informational booklet to educate the government and citizens of New Hampshire and to help make this proposed trail a reality.

Report No. 86D260I pages 20

IMPACT OF PRESTEL IN U.K. ON VIDEOTEXT IN AMERICA

Students: Samira D. Hakki
Daniel E. James
Peter J. DeLeon
Advisor: G. C. Branche

This paper analyzes the U.K.'s public videotext service, Prestel, and applies the results of this analysis to the future implementation of such a wide-scale videotext service in America. Research was conducted in Great Britain through personal interviews, library research, and independent study. Many facets of Prestel are examined in this paper, including marketing, consumer reaction, and many of the services available to the user. We conclude with advice for the U.S. videotext market and recommendations for further study.

Report No. 86D265I pages 132

RESTAURANT SITE REQUIREMENTS AND ZONE ORDINANCES

Students: Edward M. Paquette
Michael M. Foley
Jay E. Harper
Advisor: F. D. DeFalco

This report describes the process involved in designing a restaurant given two criteria - 1) site influencing factors and 2) the owner's desires. Another useful tool in designing the restaurant was a survey of local restaurants. This criteria combined with an analysis of the survey will form the design of the restaurant.

Report No. 86D274I pages 57

POWER TRANSFORMATION OF WORCESTER'S INDUSTRIES

Student: Alan R. Johnson
Advisor: J. E. Watters

This project, which was done in conjunction with the Worcester Historical Museum, explores the effects that the transition from waterpower to steampower had on the city of Worcester, MA. Working from pictures, maps, and various other documents, Worcester's industries were plotted in early 1800's to 1870.

Report No. 86D288I pages 61

TRAFFIC OBSERVATION STUDY

Students: Jamie George King
Mark Lafleur
Michael G. Thompson
Advisor: T. Hammond

Several intersections in the city of Worcester rank higher than most, in terms of the number of accidents which occur there each year. The reasons for these high accident rates are not always apparent. This study examines one of these intersections, and through various observation techniques, attempts to show that confusion exists at the intersection under study due to a non-standard traffic signal display.

Report No. 86E022I pages 116

AN ANALYSIS OF TRIP GENERATION RATES OF RESTAURANTS IN WORCESTER, MA

Students: Donald R. Costello
John W. Hughes
Advisor: R. D. Desrosiers

The objective of this project is to evaluate the trip generation rates of high-turnover, sit-down and drive-in restaurants in Worcester, MA. Data will be collected in the field and evaluated according to the guidelines of the Institute of Transportation Engineers. The data can then be compared to the values given by the I.T.E. to determine how well the I.T.E. values apply to these land uses in the Worcester area.

Report No. 86A026I pages 31

CATEGORY II AND ITS EFFECT ON WEATHER FLIGHT CANCELLATIONS

Student: Martin J. Moran
Advisor: R. D. Desrosiers

This report will research the impact of establishing a Category II Instrument Landing System at Worcester Municipal Airport. The technology behind the "CAT. II ILS" will be discussed. Weather and flight cancellation records will be deciphered to determine a need (or lack thereof) for an improved landing system. Conclusions will be drawn based upon initial costs versus long term impacts.

Report No. 86B025I pages 69

CABLE TV BASED REMOTE METER READING IN SHREWSBURY, MA

Students: Thomas R. Bogaczyk, Jr.
Mark S. Hansen
Nicholas M. Werthessen
Advisor: G. C. Branche
J. S. Demetry

Remote metering over cable television lines is a relatively new concept that has never been implemented on a large scale. This report presents a study on the possibility of implementing a cable-based remote metering system in the Town of Shrewsbury, MA. It includes a detailed analysis of the technical, economic, and social feasibility. From this analysis, conclusions and recommendations were prepared for Shrewsbury's electric and cable systems.

Report No. 86A017I pages 443

MUNICIPAL REVENUE SOURCES: MASSACHUSETTS VS. 17 STATES

Students: Robert J. Michaud
William R. Riccio, Jr.
Jonathan S. Wyman
Advisor: J. A. Soetens
J. S. Demetry

This report, prepared for the Massachusetts Municipal Association, studies how municipalities across the nation generate revenues. The study concludes that municipalities in Massachusetts (and the other New England states) are a typical in their reliance on particular revenue sources, as compared to similar communities in other states. Recommendations are made for consideration of potential alternative local revenue sources and for the expanded use of revenue categories which presently exist but are underutilized.

Report No. 86A054I pages 144

OPEN SPACE PRIORITIZATION

Student: Douglas D. Bacon
Advisor: E. B. Silver

The result of this project was the development of a method of prioritizing open space for civic protection. To identify public concern on open space a survey was conducted. The results of the survey formed the basis for the prioritization method. The projects was performed under the direction of Evelyn B. Silver, Project Coordinator of the Regional Environmental Council, and Joseph McGinn, Chairman of the Worcester Conservation Commission.

Report No. 86B010I pages 36

A FEASIBILITY STUDY OF DIRECT BROADCAST SATELLITE TELEVISION IN THE UNITED KINGDOM

Students: Richard F. Buckley
Allen M. Hall
Advisor: G. C. Branche

This paper investigates the present state of direct broadcast of television by satellite (DBS) in the U. K. and attempts to determine the feasibility of such a system for the U. K. Research was conducted in London through personal interviews, library research, and independent study. After introducing the DBS concept, the U. K. DBS experience is chronologically analyzed to determine the reasons why it has not as yet been inplemented, From this analysis, recommendations are formulated concerning the future implementation of DBS in the U. K.

Report No. 86A021I pages 167

ALTERNATIVE REVENUE SOURCES

Students: John E. DiLorenzo
Teresa B. Tucchio
Derek A. White
Advisor: J. S. Demetry

This report, prepared for the Worcester Department of Public Works, researchs the possibility of implementing an infrastructure inspection fee. Using time records, plans of developments, and interviews, we suggest the institution of an on-site inspection fee based on the total number of lineal feet of infrastructure in a development. We further recommend that the Department of Public Works should consider increasing the fee charged for the review of plans and assessing the inspection fee at the outset of the project.

Report No. 86B052I page 179

THE WORCESTER CONSORTIUM AND THE GREATER MEDIA CABLE INSTITUTIONAL NETWORK

Students: Bryan T. Outlaw
Thomas C. Riley
Kenneth E. Viall
Advisor: G. C. Branche

This paper attempts to determine whether or not it is feasible for the Worcester Consortium for Higher Education to utilize the institutional network which is to be constructed in Worcester Greater Media Cable. This study was conducted through personal interviews, and library research, as well as by reviewing product information. From this analysis it was concluded that the Consortium should consider future use of the institutional network. Recommendations for further study were also presented.

Report No. 86B069I pages 280

COMPARISON OF UNITED STATES AND BRITISH MAXIMUM SPEED LIMITS

Students: Scott W. Tougas
Garrett D. Sickles
Jay F. Crochiere
Advisor: R. R. Borden

This report is a comparison of maximum highway speed limits of the United States and the United Kingdom. Research was conducted primarily at the Department of Transport in London, England and the Massachusetts Department of Transportation. Major factors influencing speed limits were: public opinion, enforcement, car safety, energy savings, highway design, and accidents. The conclusion is that when these factors are compared significant differences exist which justify the higher limit of 70 MPH in the United Kingdom.

Report No. 86B050I pages 103

THE BLACKSTONE RIVER AND CANAL HERITAGE STATE PARK IN WORCESTER

Students: Donald Pagel
John Desmond
Carl Morth
Advisor: J. P. vanAlstyne
E. B. Silver

The Heritage State Park Program is revitalizing cities and towns all over Massachusetts. Construction of the Blackstone River and canal Heritage State Park in Worcester will provide an economic boost to the city and new recreational opportunities. Dem has plans to develop the southern section of Worcester. In addition to the greenway planned for southern Worcester, this study proposes the Harding Street area to house a visitors' center with interpretive displays because of its historical value, accessability, and development potential.

Report No. 86D305I pages 99

DRIVING PERFORMANCE STUDY

Students: Brian P. Bagdonovich
Eric S. Kaufman
Vicki Leong
Advisor: R. D. Desrosiers

This report was a study conducted at an actual intersection. Driver reaction when faced with a decision scenario was the purpose. The study obtained a representation of how particular categorized drivers reacted to an amber traffic signal. This study is to be used in conjunction with test track results of a comparable situation at Liberty Mutual Insurance.

Report No. 86D002I pages 57

MASSACHUSETTS CENTRAL RAILROAD RIGHT-OF-WAY

Student: Steven Connors
Advisor: R. R. Borden

The 100 mile railroad right-of-way through central Massachusetts is analyzed with respect to its history, present condition (include ownership and uses) and future prospects such as rapid transit, freight railroad, utility corridor, and bikeway.

Report No. 87D139I pages 52

AN APPLICATION OF TRAFFIC CONFLICT ANALYSIS

Students: Paul Pender
Adam Sandahl
Michael Marion
Advisor: R. D. Desrosiers

This project deals with the application of a technique known as Traffic Conflict Analysis. Several intersections, in the City of Worcester, were studied in an effort to determine if this technique can be used to estimate the number of accidents that will occur at a given intersection over a period of time. This project employs several techniques of data collection commonly used in the civil engineering field.

Report No. 87D261I pages 83

A STUDY ON BOSTON WATER TRANSPORT

Student: James Coffin
Advisor: R. R. Borden

The purpose of this study is to assess the feasibility of water transit systems for the metropolitan Boston region. Investigating the nature and pertinant characteristics of the present transit systems and developing a proper water transit system are the main objectives of this report. The success of the proposed system will be determined by analyzing it for positive commuting and economic characteristics.

Report No. 87D138I pages 52

COAXIAL CABLE TRUNK RUN ALTERNATIVES - A COMPARISON

Students: Patrick E. Murray
William D. Rouse Jr.
Joseph E. Scier
Christopher P. Vlangas
Advisor: G. C. Branche

Greater Media Cable (GMC) of Worcester, MA is in need of a communications link that will carry four television signals from a point of reception in Leicester to the point of distribution in Worc. Fiber Optics coaxial cable, and microwave transmission are all feasible methods to accomplish this link. The purpose of the project is to evaluate and compare these three alternatives and based upon their overall cost, reliability efficiency, and future expansion capacity, to make recommendations to GMC.

Report No. 87D275I pages 200

A STUDY OF THEFT OF CABLE TV SERVICE IN WORCESTER

Students: Timothy P. McElroy
Daniel A. Powell
Advisor: G. C. Branche

The monitoring and protection of cable television transmissions is a crucial concern to today's cable operators. This paper traces the history of the steps taken by cable television companies to combat theft of service, and focuses much of its attention on the theft of service situation in Worcester. Possible future methods by which cable television operators hope to minimize theft of service are explored and some specific anti-theft measures are recommended to the Greater Media Cable Company for Worcester.

Rport No. 87C040I pages 125

Science and Technology: Policy and Management

Faculty Coordinator:
Professor S. Vernon-Gerstenfeld

DIV 45

AVAILABLE EXPERT SYSTEMS FOR MARKETING APPLICATIONS

Students: Diane Fiorillo
Robert Day
Michael Zaramba
Advisor: H. Thamhain

This report, prepared in conjunction with Digital Equipment Corp., investigated the potential marketing applications of Expert Systems and Artificial Intelligence based products. Using a series of personal interviews augmented by an extensive literature search, our group found a number of applications for these systems. Also, we discovered a major problem, a substantial knowledge gap exists between the vendors and users of these systems.

Report No. 87C021I pages 149

HOMEOWNER'S GUIDE TO HIRING GENERAL CONTRACTORS

Student: Timothy R. Sabol
Advisor: R. R. Borden

Little do most homeowners realize that everyday, somewhere in the home contracting industry, another consumer falls into the hidden traps of dishonest contractors. Although there have been many attempts to educate the public with regards to this issue, a lack of organization of educational material has prevented many consumers from learning all which they should know. This manual attempts to combine all available information on the process of hiring a home contractor, thus solving this problem

Report No. 87C087I pages 77

A CRITICAL ANALYSIS OF DEFENSE POLICY PROCESS

Students: Robert R. Lamoureux
Richard J. Wronski
Gregory Mathis
Advisor: K. P. Ruscio

Public policy for defense involves many technological consideradions. This IQP analyse how various groups influence policy making. It presents a model which emphasizes the kinds of arguments used by the groups. Interviews with public officials supplied evidence for the model's accuracy. The model is used to access whether the process results in an effective and democratic defense policy.

Report No. 87C035I pages 76

ABORTION POLICY -- A COLLISION COURSE

Students: Valerie Tanigawa
Carolyn Mahoney
Maureen J. Theis
Tusha S. Hoskere
Advisor: K. P. Ruscio

In this project, we examined how advances in medical technology might require a change in the nation's public policy for abortion. The study consisted of interviews with legal and medical professionals, and site visits to four abortion clinics and four neonatal intensive care units. Technological developments indicate that the trimester model originally formulated by the Supreme Court in 1973 is no longer adequate. We proposed a "bimester" alternative.

Report No. 87C032I pages 80

RESPONSIBLE ENGINEERING

Student: Joe Franklin
Advisor: R. R. Borden

A study of the state of professional ethics, and the ethical dilemmas that face engineers today. Its foundation is based on responses from a student questionnaire, and an extensive literature search. The final product is a pamphlet that presents current ethical conflicts, such as employment with the Defense Department and whistle blowing.

Report No. 87D057I pages 210

A STUDY OF REGULATIONS FOR RED TIDE IN MA

Students: Pamela Jane Mercier
James E. Popp
Nicole M. Bartek
Advisor: K. P. Ruscio

This is a study of the regulations that protect the public from "Red Tide", a dinoflagellate that contaminates shellfish and makes them unsafe to eat. The roles of the federal, state, and local governments are described. Then we present case studies of two New England communities. Despite the complexity of the objectives of the policy are generally being fulfilled.

Report No. 87C056I pages 72

CONSTRUCTION DISRUPTIONS URBAN TUNNEL CONSTRUCTION MBTA RED LINE EXTENSION

Students: Stephen Faga
Richard Levergood
Advisors: G. F. Salazar
M. S. FitzPatrick

Urban underground tunnel construction activities impose costly disruptions, affecting diverse groups, and often require costly mitigation efforts. Early identification of the potential economic and social costs of disruption, as well as the costs of mitigating the disruption is essential in the evaluation of alternative construction methods or route alignments. This project identifies some of the construction activities, resulting disruptions, and the mitigation efforts associated with urban underground tunneling. The MBTA (Massachusetts Bay Transportation Authority) Northwest Red Line Extension project, from Cambridge, MA to Somerville, MA is used as a case study to illustrate the link between construction activities, disruptions, and mitigation efforts.

Report No. 86B053I pages 104

ATTITUDES TOWARD AUTOMOTIVE RESTRAINT SYSTEMS

Students: Joseph Oliveri
Matthew D. Llodra
Advisor: R. D. Desrosiers

The subject of this project is attitudes toward the use of seat belts, the psssible alternatives, and the mandatory seat belt law. A survey was conducted to determine these attitudes. The questionaire addressed these attitudes as well as personal characteristics of the subject. The survey was administered to a sample of 80 people from the Worcester area selected randomly from the telephone directory. An analysis of the results was performed and recommendations were made regarding future studies.

Report No. 87C037I pages 100

RESTRAINT SYSTEMS USAGE IN PASSENGER VEHICLES

Students: Christopher J. Wojciak
Kevin M. Windoloski
John Eric Bedard
Advisor: R. D. Desrosiers

In order to make comparisons of belt use levels during and post law, a direct observational study was used to determine restraint usage rates. These usage rates were then broken down by imposed parameters and the changes in them were analyzed and discussed.

Report No. 87C012I pages 70

THE COMPUTERIZATION OF SPACE REQUIREMENTS

Students: Marie E. McKenna
Susan M. Swidrak
Advisor: H. G. Vassallo

The purpose of this project was to find software packages that would enable GTE to computerize their plant layouts and forecast space requirements and to assess the impact of those packages on the job of the worker. We recommended five commercially available packages suitable for GTE Corporation.

Report No. 87C041I pages 199

FIRM SIZE AND INNOVATION

Student: Steven Scott Smith
Advisor: T. H. Roddenbery

This project represents an overview of economic literature which examines the influence of firm-size on the creation of innovations. Several important factors in the innovation process, such as research expenditures, managerial philosophies, and incentives for invention are explored. Our investigation indicates that while large firms in an industry are responsible for the largest total amount of innovation, small firms account for the largest portion of "quality" innovations.

Report No. 87C049I pages 75

FIREARMS SAFETY DESIGN

Student: Jason A. Mahoney
Advisor: R. R. Borden

This report examined all facets of crime including the criminals' methods, motivation, psychological state, present and past laws, solutions including parole, the death penalty, vigilantism, gun control, and focused on arming private citizens and the consequences of such a plan.

Report No. 87C039I pages 23

MINING FERROMANGANESE DEPOSITS FROM THE OCEAN

Students: Gilbert L. Tavares, Jr.
Matthew R. Whipple
Mark A. Bourne
Advisor: D. W. Woods

Ferromanganese crusts and nodules are known to contain significant amounts of the strategic metals cobalt and manganese. In addition, they contain several other valuable metals such as nickel, titanium, molybdenum, vanadium, and cerium. An ocean mining scheme to recover these metals does not seem to be likely in the near future due to economic, political, and environmental obstacles. However, an increase in the average ore price on the order of 25% or a sudden disruption in the supply of strategic metals from foreign sources could make crust mining attractive.

Report No. 87C001I pages 109

SUPERVISORY SKILLS AND THEIR IMPACT ON JOB SATISFACTION OF YOUNG ENGINEERS

Student: Timothy J. Noble
Advisor: D. M. Lee

This study investigates the relationship between the job satisfaction of a group of young engineers and their supervisor's technical and managerial skills. It is found that the young engineers rated their supervisor's technical skills higher than their managerial skills. In addition, the young engineers seemed to be quite satisfied with their present jobs. Finally, job satisfaction seemed to be related more strongly to the supervisor's managerial skills than technical skills. Overall, the results from this study illustrate the importance of both the supervisor's technical and managerial skills and their possible impact on overall job satisfaction

Report No. 86D301I pages 33

STRATEGIC DEFENSE INITIATIVE: ISSUES CLARIFIED

Students: Hwang Chol-Ho
Peter W. Marston
Advisor: P. P. Dunn

This report documents an investigation into and clarification, in an unbiased manner, of the issues surrounding the Strategic Defense Initiative. Discussed are the weapons system, command and control systems, political issues, and the thoughts of some WPI faculty about the workability of the system and its effects on research and education. The goal of the project is to inform the reader and thus allow him or her to make a conscious decision to support or oppose SDI.

Report No. 86D283I pages 85

THE IMPLEMENTATION OF ELECTRONIC VISION SYSTEMS

Students: Ilyoyul Oh
Michael P. Banic
Advisor: A. Gerstenfield

This project deals with the modern technology of Electronic Vision and its early implementations in the field of robotics. The reason behind the evolution of vision, the necessary components of vision, and the direction of the vision industry are some of the areas of the topic which were studied. Research into these areas eventually yielded information about the effects of vision on robotics, production, and quality control. The authors have found that there is a direct effect on the job market due to the implementation of vision.

Report No. 86D237I pages 94

COMPARATIVE STUDY OF MANUFACTURING SYSTEMS TOWARD PRODUCT IMPROVEMENT

Students: Jodi M. Griesemer
Mara B. Catlin
Benjamin F. Hantz, IV
Advisor: H. J. Thamhain

This report describes Phase II of an overall study toward automation of GE, Wilmington, MA, Aircraft Instrumentation plant. The three part field study encompasses comparative studies, preliminary vendor analysis, and a study of workers and automation. It leads to recommendations on plant automation and implementation alternatives. In addition, the study provides a limited vendor analysis and concludes that there must be complete coordination and communication between labor/management in any decisions which directly affect the workers or resentment may result.

Report No. 86D252I pages 126

THE PERSHING II MISSILE-THE GERMAN ASPECT

Student: Christopher S. Hirst
Advisor: M. D. Halsey

This report analyzes of the factors fueling the widespread opposition to deployment of the Pershing II in West Germany. In addition to examining the origins and concerns of the peace movement, West German-U.S. relations are investigated as pertains to the 1979 dual-track decision. Recommendations concern future policy geared to decreasing the rift between the peace movement and the German government, as well as easing the strains between the U.S. and West German governments.

Report No. 86D280I pages 41

POLYGRAPHY AND EMPLOYMENT

Students: Mehrdad Givehchi
Mehran Nayeri
Advisor: P. P. Dunn

In the project the students completed a historical survey of methods of "lie detection", reviewed the search concerning its validity and reliability; described the types of tests and their use by private employers, criminal investigators, and the federal government; and examined legislation concerning such use. The authors conclude, that, given the lack of scientific proof for the assumptions of polygraphy and lack of controls during its use, it is an inappropriate and ineffective method of "lie detection".

Report No. 86E020I pages 87

COMPUTERS IN MANAGEMENT ENGINEERING

Student: Anselmo Batschauer
Advisor: A. F. Chalabi

CCSYM4, a construction project management package, utilizes sophisticated scheduling and resources management capabilities to enable managers to optimize and accomplish objectives on time and on budget. The package includes critical path analysis, resource allocation with limited resources, cost analysis, progress bar charting, calendar dated scheduling, daily crew assignment scheduling, resource level bar charting, monthly cash flow reporting, status reporting, resource utilization reporting and updating.

Report No. 86B001I pages 219

TECHNOLOGICAL IMPACT OF WORD PROCESSING

Student: Erik Johnson
Advisor: T. Hammond

The corporate office structure of today is vastly different from that of years past. This paper deals with the changes which have occurred both physically, and socially due to the implementation of word processing systems. A change in the relationship between a secretary and a manager was discovered. By following the evolution of word processing insight may be gained as to the attitude towards employees the corporate office structure will follow in the future.

Report No. 86E008I pages 34

COMPUTERS IN CONSTRUCTION MANAGEMENT

Student: Douglas A. Tenney
Advisor: G. S. Salazar

This report reviews the current trends in the area of computerized project management and provides recommendations for the implementation to those contractors contemplating the incorporation of available technology into their firm's operation.

Report No. 86A050I pages 113

MANAGEMENT-OPERATION GOVERNMENT LABS AND THEIR AVAILABILITY TO UNIVERSITIES

Students: Joanne M. Krawczyk
Jean P. Laiosa
Simone A. Shields
Advisor: K. P. Ruscio
S. J. Weininger

Many government agencies are changing the management and operations of their Federal laboratories. Some of these changes are a direct result of the trend toward privatization. In the midst of these changes, one of the concerns is the availability of the laboratories to academia. This report, which was prepared for the National Science Foundation, evaluates some of the effects of privatization in certain Federal laboratories, as well as the importance of university access.

Report No. 86B059I pages 99

FORMALDEHYDE EMISSION IN THE FURNITURE INDUSTRY

Students: Cheryl M. Hagglund
Gregory S. Hallee
James S. Wachala
Advisor: K. P. Ruscio
S. J. Weininger

This report, prepared for the American Furniture Manufacturers Association, has two purposes. The first is to design a handbook listing adhesive manufacturers and their currently available glues which emit little or no formaldehyde, when used in producing furniture. The second purpose is to analyze the federal regulatory process. We identified one problem in the regulatory process and offered our recommendations for improvement.

Report No. 86B058I pages 168

YOUNG ENGINEER'S PERFORMANCE

Students: Sami Bazzari
Karla Sami El-Khoury
Advisor: D. M. S. Lee

This study investigated the effects of workload and time pressure on the job performance and job satisfaction of young engineers. It was found that workload and time pressure have a significant positive correlation with the young engineer's job performance. In addition, workload and time pressure was found to have a significant positive correlation with the engineer's satisfaction with the opportunity for advancement. Time pressure was found to have a significant negative correlation with the engineer's nature of work.

Report No. 86A018I pages 18

MONEY TRANSFER DUE TO FIRE

Students: Robert W. Grzyb
Peter G. Hamill
David P. MacGregor
Cheryl G. Melendy
Advisor: R. W. Fitzgerald

This project developed a method to estimate the annual loss due to fire in the United States. Empirical factors were developed to convert broad based insurance statistics into fire loss statistics. In addition to insurance data, other sources, such as the National Fire Incident Reporting System (NFRS) and the National Fire Protection Association annual survey, were used to correlate and compare results.

Report No. 86D279I pages 91

CAPACITY OPTIMIZATION SPREADSHEET

Students: Paul J. Gaynor
Jeffrey D. Lord
Donald H. Petry
Advisor: H. G. Vassallo

The purpose of this IQP was determining workcenter capacity of the Printed Wiring Assembly (PWA) department for GTE in Needham. A Capacity Optimization Spreadsheet (COS) was developed specifying monthly manual/machine output increases needed to meet scheduling requirements. PWA uses COS to predict number of manhours, machines and floorspace for future production. The second half of the project dealt with developing a COS User Manual, and studying how a production increase, through COS planning, affects the worker both physically and psychologically.

Report No. 86A033I pages 158

SAGE AND STAR WARS, COMPUTERIZED MILITARY DEFENSES

Student: Eric J. Meerbach
Advisor: M. D. Halsey

I examined the SAGE air-defense system and basically found out if it was a good investment for the U.S. There was four major topics covered in each section - origin, description, evaluation and conclusion. Each section thoroughly discussed certain aspects about its respected computerized defense system. These aspects basically covered information describing where the system came from and how it operates. There was also a section that exposed the world impacts each defense system had encountered.

Report No. 86A043I pages 88

INFLUENCE OF TECHNOLOGY OF WINE PRODUCTION ON PUBLIC

Student: Anthony V. DeSpirito, Jr.
Advisor: J. M. Borden

This paper will describe wine production technology in California, past and present, and examine its influence upon the American public. Working from periodicals, textbooks and personal interviews, we are able to describe the California Wine Industry, the changes and advancements in the technology of production during the last sixty years and the impact of these changes, if any, on the American public. Specifically, we examined (1) The Classical California Wine Industry and its production techniques, (2) The advancements in technology over the last sixty years and (3) Attempts to show a connection between these advances in technology and their influence on the American public.

Report No. 86A051I pages 85

A SURVEY OF NATIONAL INNOVATION WORKSHOPS

Students: Joseph A. Cappuccio
Vonnie M. Karas
Christopher F. Lanctot
Advisor: R. Long
L. E. Wimmergren

This report, prepared for the National Society of Professional Engineers, provides the analysis of a survey on the topic of the National Innovation Workshop Program. The purpose was to determine the impact of the workshops on the individual inventor and the inventor community. The results contained in this report show the workshops have served their purpose by providing an opportunity for inventors to establish contacts, exchange ideas, and obtain valuable information.

Report No. 86A023I pages 305

INTEGRATION OF MANAGEMENT AND ENGINEERING SKILLS

Students: Matthew T. Bush
Timothy J. Lynch
Dennis Nagle
Advisor: T. H. Roddenbery

In recent years it has become increasingly apparent that a sizable portion of the engineering profession is involved in managerial or administrative work. This project investigates the reason why this is so and researches the methods being used by engineering schools and companies to develop proper management skills in engineers.

Report No. 86A022I pages 54

AN EXPERIMENT IN INTEGRATION OF U.S. AND JAPANESE MANUFACTURING

Student: Christian Schuster
Advisor: A. Gerstenfeld

General Motors and Toyota start to produce cars in the United States, using Japanese manufacturing techniques. It was a difficult start, but the joint venture terns success. The joint venture is a breakthrough in the implementation of Japanese manufacturing efficiency.

Report No. 86A048I pages 28

COST ESTIMATING MODEL FOR RILEY STOKER VR BOILER

Students: Michael R. Oliver
John Wysocki
Advisor: H. Thamhain

This IQP report describes the efforts and results of an on-site project with the Riley Stoker Corporation, leading to the development of a cost estimating model for custom designed VR boilers. The final cost estimate is dependent on the customer's desired performance specifications. The model enables calculation of a budget price for the VR boiler quickly and accurately, reducing the amount of financial uncertainty and improving the bid proposal response time.

Report No. 86B004I pages 99

AUTOMATION OF PRINTED CIRCUIT BOARD ASSEMBLY

Students: Thomas J. Cummings, Jr.
Thomas B. Loring
Advisor: H. G. Vassallo

This project, sponsored by GTE, involved the study of accumulated data to provide information about printed circuit board assembly. The main objective of this IQP was to find a system to eliminate lead trimming after wave soldering, and to study worker behavior towards the implementation of such a system. A decision support system was constructed in the form of a matrix. This matrix enabled us to recommend a system fulfilling the project objectives.

Report No. 86A027I pages 180

MASSACHUSETTS STATE LOTTERY - THE ODDS

Students: Dave DiSalvio
David Gouin
Advisor: E. L. O'Neill

This report calculated the actual odds for Mass State lotteries, and compared of actual odds and published odds.

Report No. 86B007I pages 27

ADVANCED MANUFACTURING: A TRIAD

Student: Charles O. Stanwood
Advisor: A. Gerstenfeld

This project described and presented various aspects of stockless production in use in Japan and the United States. Working from interviews and literature, the project assesses the benefits of such a system. Stockless production is made up of an interconnected triad: 1) human relations, 2) statistical process control, and 3) "just in time" methods. Fundamentally, the triad works by involving workers in quality control and eliminating waste within the process.

Report No. 86B006I pages 63

THE EFFECT OF TECHNOLOGY ON EMPLOYMENT IN THE TEXTILE AND APPAREL INDUSTRY

Students: Timothy Kelley
Thomas Kubacki
Seven Ouellette
Advisor: L. E. Wimmergren
R. Long

This report, prepared for the Department of Labor, studies the effect of technology on employment in the textile and apparel industries. The impact of international trade on the industries was analyzed and it was determined that import competition was a major reason for automation. When companies automate there is a change in job structure, employment level, wages, skill level, and worker productivity. Recommendations were made for subjects of future study and suggestions were given for policy to best help workers.

Report No. 86A038I pages 94

A COMPARISON OF U.S. AND W. GERMAN INDUSTRIAL SALES

Students: Martin J. McDonough
Damir Juric
Advisor: H. Thamhain

This IQP analyses industrial sales techniques in Germany and compares them to U.S. practices. Through literature and interviews, the cultural and business environments of Germany are observed and analysed. In addition a survey of German industrial firms is conducted. The differences between U.S. and German industrial sales techniques are shown and recommendations are made to U.S. industrial sales personnel for effectively conducting business in West Germany. The data were collected by the authors during a one year exchange program in West Germany.

Report No. 86B024I pages 169

ATHLETE ALLOCATION METHOD: THE NFL DRAFT

Student: Lawrence E. Weaver
Advisor: D. Housman

The equity and efficiency of the National Football League (NFL) draft is discussed. The present method of allocating new talent is evaluated using several methods suggested by the literature. Results obtained show that the NFL draft does promote parity in the league. However, several flaws were discovered in the present system. Two allocation methods are proposed to eliminate these flaws and improve the present NFL draft.

Report No. 86B076I pages 122

A STUDY OF PRINTED WIRE BOARD TESTING AT GTE

Students: John Calcio
Jonathan E. Perry
Advisor: H. G. Vassallo

This project, sponsored by GTE, focuses on the percentage of failures of different one layer and multilayer printed wire boards. The purpose of these percentages is to aid GTE in the analysis of the methods used in the testing of PWB's. Secondly, we researched and discussed the organizational behavior issues related to PWB manufacturing.

Report No. 86B042I pages 83

CULTURAL INFLUENCES UPON AUTOMATION IN JAPAN, EUROPE AND THE UNITED STATES

Students: Jay J. Russell
Joseph A. Selvaggi
Bruce A. Angelis
Advisor: D. Klein

Automation has been one of the most significant developments in the history of production technology. The purpose of this project is to determine why some regions of the world (Japan, Europe and the United States) have adapted more readily to automation. Cultural, governmental, economic and managerial differences between these regions are investigated to determine their impact on the implementation of automation. Regional statistics and expert opinions are used for comparison. This project will exhibit the theories and support data that are used to explain the variation of automation implementation in the regions.

Report No. 87D301I pages 92

TIME STANDARDS OF INSPECTION PROCEDURES BY GTE

Students: Steven Abrams
Patrick R. Boyle
Advisor: H. G. Vassallo

In this project, sponsored by GTE Communications Systems Division, twenty four flow charts were developed to determine time standards of inspection procedures. The purpose was to aid GTE in cost analysis for new contracts, specifically, justification of labor costs. An additional component was to assess the importance of motivation in the inspection process.

Report No. 87D047I pages 130

THE SECOND INDUSTRIAL REVOLUTION

Student: John Sheldon
Advisor: R. Vaz

A growing concern among the blue collar workers is the impact that robotics will have on the workplace. This paper explores different aspects of robotics including, but not limited to, two local companies' views on robotics, the impact of artificial intelligence on robotics, and different viewpoints about the future impact of robotics on society.

Report No. 87D310I pages 36

MARKETING A CONSUMER PRODUCT

Students: Arsenio Vargas
Matthew Tropper
Advisor: A. H. Weiss

Professor Alvin H. Weiss of WPI has invented a pocket-sized filter that provides ten-minute protection from the kinds of toxic gases present in fires. This project examines the market potential of this device and the marketing schemes necessary to introduce the device to the public. It also analyzes the production, distribution and promotional expenditures for product. Our findings indicate that the device prosesses outstanding market potential. But success hinges on a proper financial and marketing plan. We recommend marketing strategies and suggest production, distribution and promotional budgets for our product.

Report No. 87D329I pages 82

GOVERNMENT INTERVENTION IN CRYPTOGRAPHY RESEARCH

Students: Joseph F. Musmanno
Timothy J. Butler
Thang D. Pham
Advisor: M. D. Halsey

A conflict exists between the United States Federal Government and the scientific community over the secrecy of cryptogrphy and cryptographic research. The Government sees the need for secrecy in order to protect national security interests, while the scientific community recognizes the need for openness, to ensure growth and cross-pollination of ideas. This report attempts to explore this problem, solutions used in the past, and possible alternate approaches.

Report No. 87D113I pages 43

PROBLEMS IN SCIENCE AND MATH EDUCATION ON THE SECONDARY LEVEL

Students: Jane J. Labonte
Bryan J. Thibeault
Advisor: K. P. Ruscio

The goal of this project is to compare the views of several National Commission Reports on education to the views of the teachers, particularly the views of science and math teachers on science and math education. Interviews and questionnaires elicited the teachers' interpretation of the problems and proposed solutions. The teachers agreed with the commissions on some points but placed greater emphasis on the incorporation of technology into the classroom than on the other issues that the commission reports stressed.

Report No. 87D248I pages 165

AN ANALYSIS OF THE DEFENSE WEAPONS TESTING PROCESS

Students: Isaac Z. Davidi
Scott E. Wolpert
Gregory Tsouprake
Advisor: K. P. Ruscio

This project evaluates the Defense Department's procedure for weapons testing. Interviews with the Department of Defense officials and Congressional aides and an analysis of documents and specific cases revealed two specific problems with the way the military procures its weapons: Unclear designation of authority and Congressional micromanagement. Several recommendations are presented.

Report No. 87D160I pages 174

INDICATORS OF THE IMPACT OF DEFENSE SPENDING ON TECHNOLOGY

Student: Charles J. Slick
John J. Lamach
James A. Doran
Advisor: K. P. Ruscio

This project constructed indicators of defense spending in the United States. The particular emphasis was the impact of spending on technology. The project reviews spending for 1981, 1987, and 1988, and identifies trends in the data. The eight most significant indicators are specified. These measures are designed to help decisionmakers understand the complicated choices presented by defense policy.

Report No. 87D171I pages 65

DESIGN OF A MANAGEMENT INFORMATION SYSTEM

Student: Dana S. Smith
Advisor: K. P. Ruscio

This project analyzes the management information requirements of a small chain of sporting goods stores, New England Golf Supply. A computer based information system is proposed to support the decision-making process, which will elevate the company's competitive position. The system's design is based on information requirements of the company and key variables developed by previous researchers.

Report No. 87D040I pages 44

STATISTICAL PROCESS CONTROL

Students: Sean F. McShea
Scott D. Hanna
Advisor: F. Noonan

Statistical Process Control on open die cogging at Wyman-Gordon Company is examined. The SPC technique isolated contributors to dimensional non-uniformity of product coming from the cogging machine.

Report No. 87D219I pages 121

MICROCOMPUTER INVENTORY INFORMATION SYSTEM

Student: John L. Clark III
Advisor: D.M.S. Lee

This project is part of an integrated set of student projects which involve the design and development of a microcomputer based inventory reporting system for the Raw Materials Management Division of a Fortune 500 company. The system generates inventory turnover reports. These reports will enable managers to make better decisions regarding reordering quantities and the levels of raw materials inventory that should be kept on-hand.

Report No. 87D136I pages 51

THE SECOND INDUSTRIAL REVOLUTION

Students: Edward T. Zajac
Steven R. Holkovic
Daniel J. Kash
Advisor: R. Vaz

Developments in robotics, computer-aided design and manufacturing, robot vision systems and artificial intelligence suggest the eventual elimination of the need for skilled human workers. This report investigates this trend and its potential long and short term impact on our society.

Report No. 87D221I pages 57

HOSPITAL MANAGEMENT SYSTEMS

Students: S. Bret Bonarrigo
David J. McKnight
Jeffrey A. Bloom
Advisor: H. G. Vassallo

An evaluation and revision of the car seat loan program at the San Francisco General Hospital. This project explored the applications of management engineering and principles to hospital systems.

Report No. 87D095I pages 56

Social Studies of Science and Technology

Faculty Coordinator:
Professor J. Wilkes

DIV 46

APPROPRIATE TECHNOLOGY FOR ZIMBAWBE

Student: Daniel J. Farkas
Advisor: P. P. Dunn

This study combines the experience of the author in Zimbawbe in the summer of 1986 with study of the history of the lands now called "Zimbawbe" and the literature of "Appropriate Technology". It concludes that aid given to the country must be consistent with the villagers' culture and perceived needs, and that education is needed for both Zimbaweans and those furnishing them aid. Recommendations for improving construction, agriculture, and education on the village level are included.

Report No. 87C026I pages 55

SCIENTIFIC ILLITERACY AND THE POLITICAL PROCESS

Student: Dalita R. John
Advisor: R. Long, II

This IQP focuses on presenting a case to any American citizen that will illustrate the involvement of science through politics in his or her life. Emphasis is placed on the desirability to be scientifically literate and the responsibility of a citizen to be scientifically literate. The project reveals important political and social consequences of failing to achieve this goal.

Report No. 86D287I pages 69

STUDY OF STS TYPE PROGRAMS AT SELECTED UNIVERSITIES

Student: James C. Shea
Advisor: T. H. Keil

This report is a survey of the present status of Science, Technology, and Society type programs and curricula at a small group of institutions. The goal of the study was to examine the changes that these programs have gone through in the past decade, with the hope of comparing them to WPI's program. Though no dramatic transitions were noted, the variations in the programs did raise some points of interest.

Report No. 86D309I pages 31

SOCIAL INTERACTION IN COLLEGE RESIDENCE HALLS

Students: Sanjeev Singh
Steven W. Hall
Karen Ballou
Jonathan Crofton
Advisor: L. Goodwin

The purpose of this IQP project is to study interaction in two dormitories at W.P.I. as affected by architectural design and personal characteristics of the residents. By subjecting our survey results to statistical analysis, we were able to determine which variables contribute to high and low social interaction levels. The two dormitories under study are Founders Hall and Morgan Hall.

Report No. 86D236I pages 160

HISTORICAL PRESERVATION STUDY OF GILBERTVILLE COVERED BRIDGE

Student: Joseph H. Olaynack III
Advisor: P. Jayachandran

An examination into the history of covered bridges was undertaken, culminating in an in-depth study of the Gilbertville Covered Bridge. In conjunction with various preservation societies, engineers, town officials, and the public works department, and a public opinion survey, an effort was made to determine if this particular bridge, and other existing covered bridges warrant preservation.

Report No. 86B003I pages 98

VIEWS ON ABORTION VS. CAPITAL PUNISHMENT AT WPI

Student: Lynda J. Grzyb
Advisor: S. Vick

The project explores opinions of WPI students of American origin between the ages of seventeen and twenty-two concerning abortion and Capital Punishment.

Report No. 86B021I pages 268

FACTORS THAT BIAS TESTING THE AUTOMATED PATENT SYSTEM SEQUENCE STUDY

Students: Kevin A. Dowgiewicz
David K. Goss
David V. Purushotham
Advisor: R. Long, Jr.
L. E. Wimmergren

This report, prepared for the U.S. Patent and Trademark Office, deals with factors causing bias in the Sequence Study, a preliminary test of the Automated Patent System (APS). A literature review was performed to obtain background information on office automation, the PTO's automation efforts, and biasing issues. Patent examiners, APS test designers, and administrators were interviewed to note their comments, suggestions, and criticisms concerning the Sequence Study. Biases and their causes were identified, and recommendations were made to the PTO regarding future testing.

Report No. pages 108

EDUCATIONAL SETTING AND CAREER PLANNING

Student: Athina L. Kyritsis
Advisor: J. M. Wilkes

This report covers the conceptualization and research design for a study of influences that lead students to consider and pursue technical careers. The focal issues involve differences in program, i.e., science curriculum and extra-curricular activities, that affect career choice. The study itself is a pretest of a survey instrument on a group of high school students from many New England Schools in a summer enrichment program. Their responses are to be compared to existing data on a cross section of Worcester High School students. A co-worker will complete the report.

Report No. 87D247I pages 57

Risk Analysis and Liability

Faculty Coordinators:
Professor F. Noonan
Professor F. Tuler

DIV 47

METHOD OF RISK MANAGEMENT FOR MARINE VEHICLES

Students: Carl P. Anderson
Edward E. Cordis
Advisor: R. W. Fitzgerald

This project developed a method to assess and manage marine firesafety risks. Two major parts were addressed. First, a framework was developed for identifying potential hazards, evaluating their effects in maintaining the mission, and establishing a hierarchy of conditions. Second, the method was tested for an interdiction mission with a U.S. Coast Guard Cutter. The test used the firesafety engineering method developed at WPI to evaluate and manage fire risks.

Report No. 86B036I pages 77

SUCCESSFUL CHARACTERISTICS OF MPS VENTURES

Students: Chinh Hoang Le
Sean M. Cavanaugh
Stephen Olsen
Carmen Romeo
Advisor: F. R. Tuler

By comparing the successful characteristics of high technology ventures to the characteristics of materials processing in space (MPS) ventures, a set of successful characteristics of MPS ventures can be determined. Based on this hypothesis, this project group gathers the necessary data and performed the comparison. The result is a set of successful characteristics for MPS ventures. The report of the project group describes the approach taken and discusses the chacteristics of high technology and MPS ventures in detail.

Report No. 86B061I pages 68

POTENTIAL FIRE HAZARDS IN SOLAR HOMES

Students: John Wholey
Charles Morse
Timothy Donohoe
Advisor: J. R. Barnett

This report studies the potential fire hazards in solar installations. Both active anc passive solar systems are covered, as well as changes in architecture due to solar installations.

Report No. 86D268I pages 110

PRODUCT LIABILITY IN THE MEDICAL FIELD

Students: Ian McCain
Amy Asbury
Timothy J. Hong
Advisor: H. G. Vassallo

Product liability is an important topic in the medical field. Some of the areas of liability include negligence, breach of warranty and strict liability. Drug and device manufacturers must research and manufacture their products carefully and represent them truthfully in order to avoid liability suits.

Report No. 86D235I pages 70

MOTORCYCLE INSTABILITY: A CASE OF PRODUCT LIABILITY

Students: Elyse P. Studt
Thomas J. Cappelletti
John Whyte
Advisor: R. Hagglund

Our IQP was prompted by two accidents involving Honda motorcycles. It included a discussion of product liability, and the subject of why motorcycles wobble. We came to the conclusion that the K&G carrier can and does cause a loss of stability in bikes, and K&G is liable. This study underscores the importance of basic engineering ethics in the design and building of a product and their effect on society.

Report No. 86D249I pages 85

A CASE STUDY IN PRODUCTS LIABILITY: LINTON VS RENAULT

Students: Keith J. Mattioli
Kevin Erabino
Thomas Boggiano
Advisor: R. Hagglund

The objective of this IQP is to apply engineering analysis to products liability law. This report is the culmination of a study in the legal aspects of product design, manufacturing and consumer use. We examined the case of Linton -vs- AMC-Renault. Engineering analysis was applied to the specifics of an automobile accident, and opinions and recommendations were given as to the disposition of the liability suit.

Report No. 86D271I pages 109

NEW HAVEN COPPER COMPANY VS. LEONARD SECURITY SERVICES; A PRODUCTS LIABILITY CASE STUDY

Students: Kenneth Reilly
Charles Meyer
Kevin B. Collins
Advisor: R. Hagglund

This project is a study of a product liability suit: New Haven Copper Company vs. Leonard Security Services and Brem Services. The case involves a liquified petroleum system which shut down inadvertently and as a result of this shut down a series of explosions occurred. The New Haven Copper Company feels the Security Service's employee failed to take appropriate action when the shut down occurred. It is our goal to determine if the plaintiff's allegations are legitimate.

Report No. 86D257I pages 103

IMPACT OF SITE SELECTION ON CONSTRUCTION PROJECTS

Student: Christopher L. MacDonnel
Advisor: G. F. Salazar

The decisions made in the early part of a construction project have the greatest and longest lasting effects on the project. This study investigates the effects on the construction project due to the selection of the site. Utility theory is used to quantitatively evaluate a site for comparison with other sites. The selection of the site for the new WPI residence hall serves as a case study for this project.

Report No. 86D294I pages 48

ISSUES IN HIGHWAY TOLL COLLECTION

Student: Curt P. Duffy
Advisor: T. H. Roddenbery

In response to the Stratford Toll Plaza Crash of 1983, this study examines the disadvantages of highway toll collection. The technical problems of toll collection, such as increased accidents, delays, and pollution, are evaluated through basic engineering principles. Ethical and social norms are used in assessing the philosophical problems associated with highway tolls, primarily regressive taxation. The study also includes sections on the history of tolls and current developments.

Report No. 86A029I pages 64

CONSUMERS GUIDE TO TOXICS

Students: William E. Carroll
Debra Peloquin
Advisor: R. E. Wagner

This project examines hazardous products and wastes that can be found in the home, on the farm, and in industry. It is broken down into three main sections. The first section focuses on identifying potentially hazardous products. The second section concentrates on the safe use of these products. The third, and final section presents the best ways to dispose of hazardous wastes.

Report No. 86A024I pages 79

HAZARDS ANALYSIS

Students: Dennis P. Colleran
Sun Park
Advisor: R.R. Hagglund

This project analyzes the case of Carmen Schiavo, who is suing the Cincinnati Milicron Company (CMC) for the personal injury that he sustained on October 30, 1975, against (CMC) with the goal of determining whether (CMC) should defend the case or settle out of court. The case investigation includes a study of the accident, via depositions from the case, with applications of the theories of products liability, a comparison of the milling machines, that Schiavo was injured on, to other modes produced during the same time period. Applying the theories of Products Liability, this project team found that (CMC) was not at fault; however, the employer is the cause of this accident.

Report No. 86A025I pages 55

ACCIDENT RECONSTRUCTION INVOLVING A FORD ESCORT

Students: Wendy D. Anderson
William A. Mandel
John G. Robbins
Advisor: R.R. Hagglund

This report examines an accident involving a 1981 Ford Escort and a 1980 Buick Regal. A study was done to determine the cause of the accident. This entailed a look at the suspension system and in particular the stabilizer bar of the Ford Escort. Fracture mechanics and stress analysis were used in order to determine if the stabilizer bar would break with or without a crack and if the stabilizer bar could cause the accident. The theories of products liability law, in particular negligence, were then applied to this case.

Report No. 86A012I pages 133

THE DEVELOPMENT OF HIGH-DOSE RADIATION PRESERVATION

Student: Michael E. Brzezowski
Advisor: E. W. Ross

A review of some societal, legislative, and regulatory issues which have delayed the commercialization of food processing via ionizing energy in the United States. Background information concerning advantages and disadvantages of irradiated foods is included.

Report No. 87D109I pages 90

NUCLEAR POWER. CAN IT COMPETE WITH THE FOSSIL FUELS?

Student: John Monacchio
Advisors: V. Bluemel
J. M. Boyd
R. L. Moruzzi
M. S. Fitzpatrick

Six factors which influence the use of both nuclear power and fosil fuel power plants. These factors are the environment, economy, fuel source availability, national security, public perception and safety. The advantages and disadvantages of each power source according to the six factors are discussed and a comparison is made in an attempt to determine whether or not the benefits of using nuclear power are worth the risk involved.

Report No. 87D273I pages 72

THE DEVELOPMENT OF A JUVENILE RISK ASSESSMENT FORM

Students: Michael S. Claffey
Matthew J. Miller
Advisor: W. Addison

This report examines the development of a risk classification worksheet for juveniles in the state of Massachusetts. A need for such a form arose because the existing classification system was created for adults. The causes of deliquency and predictors of recidivism among the juveniles in the United States were determined. These factors became the risk variables on a new worksheet. Procedures for measuring these risk categories were detailed and actual scoring methodologies for the risk determinants were devised.

Report No. 87D135I pages 69

A CASE STUDY IN PRODUCT LIABILITY LAW: DAVIS VS. AMC

Students: Mike Walsh
Thomas J. Feraco
Christopher Creamer
Advisor: R. R. Hagglund

The objective of this IQP is to combine engineering analysis and the fundamentals of products Liability Law. This is by means of a case study which involves both the technical and legal aspects of product design, manufacturing, testing and consumer use. The case between Davis vs. AMC Jeep was examined in depth. It is our opinion that the AMC Jeep CJ-5 is a potentially dangerous vehicle. We concluded that Jeeps rollover due to a high center of gravity combined with a narrow tread width.

Report No. 87D149I pages 65

RECOMMENDATIONS FOR THE DESIGN OF A YOUTH FACILITY

Students: Steven R. Gardner
Jeanette M. Cheetham
Daniel B. Mitchell
Advisors: R. L. Smith
M. Donnelly

This report examines the architectural technology of youth detention facilities of the past 100 years in America. Technical architectural data (lighting and space requirements) and field observations in this paper develop guidelines for improvements.

Report No. 87D131I pages 86

RADON CONTAMINATION IN THE UNITED STATES

Students: Jeffrey M. Denker
Michael G. Madara
Advisors: M. F. FitzPatrick
J. M. Boyd
R. L. Moruzzi
V. Bluemel

This IQP examined the topic of radon contamination in U.S. households. Radon was found to be a major cause of lung cancer in the private sector. This project evaluated methods for testing homes for radon contamination and means of reducing this contamination. The project's results indicate that radon contamination could be greatly reduced through educating the public as well as the introduction of a nation-wide testing program.

Report No. 87D163I pages 76

CHILD PRODUCT SAFETY STUDY: A SAFER BABY WALKER

Students: Peter Revelas
Herman Purut
Michael Sasloff
Vincent Solferino
Advisor: R. Lui

This project focuses on eight most frequently used children's products. The products considered are found to have certain dangers associated with them. The baby walkers, the product that causes the most injuries, is studied in detail and redesigned.

Report No. 87D036I pages 96

COMMERCIAL AIRLINE SAFETY 1982 THROUGH 1987

Students: Douglas W. Hatfield
Edward J. Masterson
Joseph B. Fitzgerald
Steven J. Murray
Advisor: D. N. Zwiep

This study analyzes the safety level of scheduled commercial airlines and assesses the areas which need to be improved as of this writing: May, 1987. An extensive literature search and personal interviews with pilots, airport personnel, and a visit to a NWS windshear test site provided this IQP with the data used to make an accurate assessment of safety. This IQP lays the foundation for future IQP's in such areas as cabin design, weather alerting, management, and FAA analysis.

Report No. 87D185I pages 147

THE ROLE OF INFORMATION IN OFFSHORE OIL LEASE BIDDING

Students: Scott L. Ruoy
Mark Zapatka
John P. Hallisey
Advisor: D. Housman

This project analyzes the role of additional information in the offshore oil leasing environment. The analysis is progressive, first offering necessary background information for understanding the process and the project's goals. The emphasis is on the effect of greater information acquisition upon the government's rent recovery. Through an evaluation of Reece's mathematical model of a firm's bidding strategy and a comparison with Day's asymmetric variation model of additional information, conclusions are drawn as to the feasibility and value of additional information.

Report No. 87D217I pages 102

NUCLEAR KNOWLEDGE AND OPINION AFTER CHERNOBYL

Student: Robert Russo
Advisor: J. M. Wilkes

This survey study extends the study of nuclear knowledge and opinion at Clark University and WPI into the Post-Chernobyl period. Drawing on data collected in 1978, 1980-81, and 1985, it was possible to examine the impact of TMI and Chernobyl on student opinion. Opinion at Clark and WPI were converging until the events at Chernobyl polarized opinion again. The focus of the study is on now changing political attitudes and prevailing knowledge levels interact in momemts of crisis to form attitudes on technical issues.

Report No. 87D302I pages 91

Humanistic Studies of Technology

Faculty Coordinators:

Professor S. Weininger
Professor J. Zeugner

DIV 48

GAME THEORY AND U.S. - SOVIET RELATIONS

Students: Peter Monsen
David R. Terry

Advisor: J. F. Zeugner

The project consists of three parts: the first reviews historiographically Soviet/American conflict since WWII with attention to the SALT negotiations: the second presents basic theory of games: the third takes three fundamental game models and applies them in extensive and simplified form to the Cuban Missile Crisis of 1962, the ABM treaty of 1972 and the on-going arms race. The project concludes with a consideration and rebuttal of attacks on the viability of game theory for real world applications.

Report No. 87C006I pages 129

HISTORICAL PRESERVATION OF GILBERTVILLE COVERED BRIDGE

Student: Michael Egan
Advisor: P. Jayachandran

This IQP examines the restoration project of the Gilbertville Covered Bridge, which connects the towns of Ware and Hardwick, Mass. Many of today's existing covered bridges are deteriorating and are in need of repair. The question often arises whether or not they warrant preservation. We will attempt to add insight into this dilemma through research of this particular bridge, interviews with those involved with its restoration and a survey of residents.

Report No. 86D272I pages 87

MORAL CONSIDERATION AND ANIMAL RIGHTS

Student: Adil Dastur
Advisor: R. S. Gottlieb

All animals are equal and deserve equal moral consideration. If one considers the rights of humans but not those of animals, that person is a speciest. All animals have the right to live a natural life and to exist for their own sake. Causing of contributing to unnecessary suffering of any animal is morally wrong. After looking at the treatment of animals in agriculture, I concluded that the only morally appropriate diet is a vegetarian one.

Report No. 85B034I pages 50

ART PRESENTATION

Student: Barry C. Fougere
Advisor: A. E. Kurneta

A slide presentation with text for high school or younger students, introducing late 19th and early 20th century artist's dependence on technological advances in optics and color theory in developing Impressionist and Post-Impressionist painting practice. Examples are drawn mainly from the Worcester Art Museum.

Report No. 85D386I pages 15

PERSHING II ARMS CONTROL NEGOTIATIONS

Student: Charles T. Olson
Advisor: M. D. Halsey

Negotiations involving the Pershing II issued in a new era in NATO/USSR relations. Through examining the original negotiations decision, the bases and concerns of each side, and the chronology of talks, the failure in negotiations in 1983 is analyzed, showing there was little chance for success. However, the chance for beneficial outcome still exists and we should continue these efforts. Recommendations are presented which could improve chances in future talks.

Report No. 86D303I pages 57

THE ECONOMIC WORLD OF EMERSON BIXBY; A RURAL BLACKSMITH AND HIS COMMUNITY IN NINETEENTH CENTURY NEW ENGLAND

Students: Peter E. Gardell
Kevin Szeredy
Advisor: P. S. Onuf

This project provides a structured analysis of a socio-economic network within a rural New England community. Using the relationship between Emerson Bixby, a nineteenth century blacksmith and a few of his trading partners, we examined the importance of a bartering system to the growth and development of the economy.

Report No. 86D275I pages 73

IONIZATION AND ITS NATURAL MANIFESTATIONS

Student: James N. Myran
Advisor's J. Hanlan
V. Bluemel

The goal of this project was to build a permanent exhibit for The Worcester Science Center explaining the process of ionization. By employing a device that generates a high potential, the exhibit demonstrates the ionization of helium, neon, and argon. The potential produces an electrical discharge inside the glass spheres thereby exciting the gas molecules. Each of the excited gases emits light with a characteristic spectral distribution; they each glow a distinctive color. Interpretive text explains ionization and relates it to such naturally occurring manifestations as the northern lights.

Report No. 86D284I pages

POWER TRANSFORMATION OF WORCESTER'S INDUSTRIES

Student: Daniel McNamara
Advisor: J. Waters

This project, which was done in conjunction with the Worcester Historical Museum, explores the effects that the transition from waterpower to steampower had on the city of Worcester, Massachusetts. Working from pictures, maps, and various other documents, Worcester's industries were plotted from the early 1800's to 1870.

Report No. 86D288I pages

THE SIGNIFICANCE OF EARLY AMERICAN GRISTMILLS

Student: Joseph P. Muldoon
Advisor: J. M. Wilkes

The Old Sturbridge Village Gristmill project began as an effort to evaluate the authenticity of an exhibit. It evolved into a consideration of how important the technologies of a period are to understanding the social life of the period. The author concludes that gristmills were a core technology that shaped the period being represented. Far reaching changes in configuration of the current mill are recommended. He reviews the most authoritative period treatise on the subject and includes drawings and design specifications to make it representative of mature Gristmill Technology - as well as an eye catching exhibit.

Report No. 86E027I pages 66

A SOUND WHEEL EXHIBIT AT THE WORCESTER SCIENCE CENTER

Student: Donald Gaiter
Advisors: V. Bluemel
J. P. Hanlan

This report describes the design and construction of an interactive exhibit that demonstrates sound generation by a toothed wheel striking a membrane, and the use of this principle by crickets to chirp. Accompanying signs and pictures explain and complement the exhibit. The exhibit will be displayed at the Worcester Science Center.

Report No. 86A032I pages 69

AMERICAN RESPONSE TO JAPAN'S THREAT IN SEMICONDUCTORS

Student: Kevin C. Quan
Advisor: J. F. Zeugner

The project focuses on the American response to the increasing Japanese threat to the semiconductor industry. Beginning with an overview of the industry worldwide, the project analyzes the American response in technology innovation, marketing and management techniques, and government policy. The project concludes with several recommendations (some already implemented): the increase of R&D capital; increase of innovation in process technology; adoption of new management styles; and new long range strategic analysis.

Report No. 86A046I pages 127

HEAT TRANSFER EXHIBIT FOR THE NEW ENGLAND SCIENCE CENTER

Students: Timothy W. Jordan
James West
Advisors: J. P. Hanlan
V. Bluemel

This project involved the development of an educational exhibit for the New England Science Center, demonstrating the principles of radiant and convective heat transfer. The demonstrations require viewer interaction and are explained on the exhibit in a manner understandable by the average museum visitor

Report No. 87D232I pages 36

EQUIVALENCE OF LEVERS AND HYDRAULICS: AN EXHIBIT

Students: Douglas R. Adams
Geoffrey C. Thomas
Advisors: J. P. Hanlan
V. Bluemel

This report describes the design and fabrication of a science exhibit that demonstrates how a simple lever relates to a hydraulic piston. The exhibit will be a permanent display at the New England Science Center. It consists of two models, the first contains three levers which visitors may depress to lift a weight. The second contains a hydraulic system that three input pistons which visitors may push to cause a weight to lift. The models interact with the museum visitors allowing them to see and feel the reactions. Accompanying text is intended to excite curiosity about the principles of levers and hydraulics.

Report No. 87D049I pages 51

CYBERNETICS AND CONTEMPORARY FICTION

Students: Patrick M. Brennan
Ralph Desrosiers
Advisor: L. Schachterle

This project examines the history and concepts of cybernetics and analyzes the impact of cybernetics on literature. Cybernetic ideas of control and communication are used by authors both as themes and as guiding principles of style. Several authors' works are examined for cybernetic influence. The final chapters make a comparison between cybernetic systems and artistic systems, from which it is apparent that cybernetics forms a link between science and literature.

Report No. 87D103I pages 188

SOUND WHEEL EXHIBIT AT NEW ENGLAND SCIENCE CENTER

Student: Gregory Engert
Advisors: V. Bluemel
J. P. Hanlan

This exhibit and report describes the design and construction of an interactive exhibit that demonstrates sound generation by a toothed wheel striking a membrane. That is the principle used by crickets in chirping. Accompanying text and illustrations explain and complement the exhibit which will be displayed at the New England Science Center.

Report No. 87D179I pages 76

STRUCTURE AND DEVELOPMENT OF ENGLISH MEDIEVAL TOWNS

Students: Rudolf J. Minar, Jr.
Steven N. Kemp
Mark E. Curran
Timothy M. Holland
Robert J. Labich
Advisor: E. M. Parkinson

Part I is a research paper assessing different facets of medieval towns and their technology: physical layout, social structure, gilds and commerce, agriculture, and the rules of cathedrals and castles in urban life. Part II, done in conjunction with the Higgins Armory Museum, Worcester, is an interactive activity based on Part I. Targeted at the six-to-twelve year old group, this activity will be incorporated into the Armory's Quest Gallery.

Report No. 87D156I pages 218

ANALYSIS OF TIMBER FRAME CONSTRUCTION

Student: John C. Dudzinski
Justin Ford
Brett Wagner
Advisor: P. S. Onuf

This project analyzed the development of timber frame construction in early nineteenth century New England. The focus of effort was on the analysis of a series of frame joints that revealed a consistent pattern of overbuilding. Project members tested formulas in contemporary carpenter's guides, concluding that builders were well aware of structural requirements. Old Sturbridge Village will use these results in future projects.

Report No. 87D172I pages 80

FILM MAKING: THE TECHNOLOGY BEHIND THE CREATIVITY

Students: Barbara C. O'Toole
Christina Ricciuti
Advisor: R. L. D. Custer

A film, even a documentary, does not display life spontaneously. Film is a studied and engineered art, in which emotions, words and actions are visually displayed in a minimal amount of space, carried in a brevity of time. This report analyzes film as a medium of communication and the studied effects which exist as an aid and guide to film makers, presented for the benefit of students wishing a literacy in the theories and elements of film and screen image.

Report No. 87D282I pages 146

NEW ENGLAND WATERMILLS

Students: Milosh T. Puchovsky
Anthony P. Kondek
Advisor: P. S. Onuf

This project develops a method for reconstructing the characteristics of New England watermills through field work at dam sites, map analysis, and documentary research. The authors provide a complete description of selected mill sites and suggest appropriate steps for future research.

Report No. 87D244I pages 101

STRESS MANAGEMENT THROUGH YOGA

Students: Robert M. Barta
Mario M. Galasso
Ciro DiMeglio
David R. Ouellette
Kevin Bennett
Advisor: R. S. Gottlieb

In this IQP, the issues of stress as it relates to western society will be examined. The eastern discipline of Yoga will be introduced as a possible alternative for the way western society deals with stress. The individual's responses to the physical, mental, and emotional aspects of Yoga will be described.

Report No. 87D077I pages 127

TECHNOLOGY OUT OF TIME

Student: Donald W. Bairley
Advisor: P. Green

Technology of of Time is a multi-year project which investigates evidence suggesting that technology, far superior to that which is traditionally attributed to the time, existed in man's past. Any evidence of such misplaced technology which was found was researched and compared with current theories of technological history. The information and conclusions were entered into a data base. This evidence was gathered in a logical fashion in order that, in the future, theories may be proposed to explain these occurrences of "technology out of time" that would satisfy the researched information.

Report No. 87D069I pages 96

DESIGN STUDY OF ANTIQUE TIN TRUNKS

Students: George E. Gikas
Sharon K. Sabat
Advisor: P. S. Onuf

This project was based on the analysis of the design characteristics of a large number of tin trunks from New England and New York. Statistical analysis of this data enabled the project team to identify a sizable proportion of previously unattributed trunks with specific tin shops. The data analysis was supplemented by research on the history of the American tinware industry.

Report No. 87D198I pages 139

A HISTORICAL APPLICATION OF ANALYTICAL CHEMISTRY

Students: Eileen L. Sullivan
Scott Breining
Advisors: R. C. Plumb

In this project, a study of plaster samples taken from a 19th century blacksmith's house recently relocated to OSV was undertaken. Several research questions concerning the sequence of room plastering were posed by OSV. A number of instrumental techniques supplied the necessary data to conclude the plasters were composed of lime, sand, and hair. Visual study and iron and magnesium analysis allowed similar plasters to be grouped together. Three distinct groups of plasters resulted, correlating well with historical documentation provided by Old Sturbridge Village.

Report No. 87D102I pages 48

CAMOUFLAGE IN ANIMALS

Student: Donna M. Grimaldo
Advisor: J. E. Miller

An exhibit entitled "Animal Camouflage" was designed and partially constructed for display at the New England Science Center. Three tanks were proposed for the exhibit: a static tank with preserved animals, an aquatic tank and a reptile tank in order to convey the subject of animal camouflage to children. The interpretive text for each tank was developed for use in case the science museum actually decided to finish the exhibit, house it and put it on display.

Report No. 87D207I pages 35

Economic Growth, Stability and Development

Faculty Coordinator:
Professor L. Graubard

DIV 49

FIRM SIZE AND INNOVATION

Students: Steven Scott Smitt
Steven Winoker
Advisor: T. H. Roddenbery

This project represents an overview of economic literature which examines the influence of firm-size on the creation of innovations. Several important factors in the innovation process, such as research expenditures, managerial philosophies, and incentives for invention are explored. Our investigation indicates that while large firms in an industry are responsible for the largest total amount of innovation, small firms account for the largest portion of "quality" innovations.

Report No. 87C049I pages 74

ECONOMIC HEALTH OF THE ELECTRIC UTILITY INDUSTRY

Student: Robert Wojciak
Advisor: D. W. Woods

In our report, we examined the financial healh of investor owned electric utilities from 1968 to 1984. The power industry's rate of return on equity market to book value ratio of common stock, and bond ratings all plunged after the energy crisis mainly because of massive fuel and construction cost increases, tighter environmental regulation, excess generation capacity, and regulatory lag. Companies continued to do poorly until the early 1980s. However, the industry's economic health has markedly improved in recent years.

Report No. 87C052I pages 122

THE ROLE OF THE US IN MODERNIZATION OF THE THIRD WORLD

Student: Sungho Kim
Advisor: J. E. Watters

The role of U.S. corporations in modernization of the Third World was studied. U.S. corporations, who go to the Third World for raw material and cheap labor, dominate local industries with their advanced technology and management skills. This enables U.S. corporations to control the major portion of the Third World economy. U.S. corporations are often supported politically and militarily by the United States who seeks favorable political stability in the Third World.

Report No. 86D291I pages 78

TRADE POLICY IN U.S. FROM REVOLUTION TO PRESENT

Student: Normand J. Bergeron, Jr.
Advisor: T. H. Roddenbery

A history of protective tariff laws and trade policy in the United States from the American Revolution to the present day is given. A comparison is drawn between the economic theory of each period in relation to the trade policy that was followed during that time. The current state of world trade is discussed in an attempt to explain a recent trend toward increased protectionism.

Report No. 87D087I pages 62

EFFECTS OF MILITARY SPENDING ON SOCIETY

Students: David Giacheri
Michael Cherry
Advisor: R. L. Smith

This IQP in the area of social policy and the allocation of economic resources, analyzes the effects of military spending since the Cold War on the civilian economy and domestic social programs.

Report No. 86D255I pages 89

A COMPARATIVE STUDY OF ECONOMIC REVITALIZATION

Student: Paul R. Darcy, Jr.
Advisor: T. H. Roddenbery

This project examines and compares programs currently in progress in Lowell, Mass., and Akron, Ohio, to revitalize depressed economies in these cities. Both programs involve restructuring the technological bases of the economies. Data used in the assessment included unemployment rates, construction activity, and public and private involvement and investment. The Lowell project has been strikingly successful, and the Akron project, still in its formative stages, seems likely to produce successful results from a different approach.

Report No. 86D262I pages 89

HIDDEN ASSETS

Student: Rebecca Lynn Crowell
Advisor: L. E. Wimmergren

I have researched all technical aspects of real state investment and hope to satisfy the social needs of anyone who has the desire to become independently wealthy or just secure their own home. The intention of this manual is to learn the steps taken to unlock your "Hidden Assets", and how to think creatively. It is hoped that the readers will learn how to substitute ideas for cash from the research done beyond the conventional real state transaction.

Report No. 86E003I pages 86

THE STUDY OF REED PLATICS, EMPHASIZING THE LAB

Students: Laurence Bennett
Mark Dunn
James Madigan
Advisor: P. S. Chong

The study examined a medium-sized color concentrate company to determine inefficiencies which could prevent future growth of the company.

Report No. 86E002I pages 161

OYSTER SHELL PROCESSING

Student: Romi Wadhwa
Advisor: J. A. Mayer

Ghana is a developing country in West Africa blessed with many natural resouces. Unfortunately, due to the lack of technology and large scale investment, these resources are not fully exploited. One of these resouces, oyster shells, lie in huge deposits along the River Volta, the country's largest body of water. These shells are the raw material for lime, putty, cement, glass, poultry feed, etc. By establishing small scale oyster shell processing industries in the rural areas where these shells lie, much of the otherwise wasted shells can be utilized for industry to benefit the country.

Report No. 86E028I pages 47

CULTURE OF POVERTY AND THE WELFARE STATE

Students: Andrew E. Horch
Taiji Saotome
Advisor: R. S. Gottlieb

The central theme of this IQP is the culture of poverty and the society which causes it. We have focused our attention on the historical development of public welfare practices, the people who are in poverty, why these people can not get out of poverty, and one program which succesfully brings people permanently out of poverty. We have also considered the program's implications on the future of public welfare in the U.S.

Report No. 86D281I pages 105

ELECTRONIC CONNECTOR GUIDE

Student: James W. Nicholson II
Advisor: L. E. Wimmergren

In the electronic industry one of the most common sources of hardware failure are the electronic connectors. The intention of this guide is to provide the reader with an overview of two connector applications and a methodology for analyzing which connector offers the user the most value. The lack of connector standards in some cases is a source of frustration among users and a general analysis of the connector market will be provided. A strategy for the defense of the domestic connector market will be included.

Report No. 86B067I pages 53

INDUSTRIAL RISKS IN VENEZUELA

Student: Anuar Barake
Advisor: L. S. Graubard

This report discusses the main physical risks that affect the Venezuelan industry. It identifies the motives that initiate these physical risks, and analyzes the effects that daily exposure to these risks cause on human beings. The methods of control to prevent these risks ar also studied, and finally a case study of an electrical accident is analyzed with various recommendations for its solution.

Report No. 86B011I pages 61

THE ENTREPRENEUR AND SMALL BUSINESS IN IRELAND

Student: Robert J. Kenny
Student: A. Gerstenfeld

The objectives of the project was to study some of the differences in the business climates of Ireland and the U.S. The project focuses specifically on the problems faced by the Irish entrepreneur when starting his own business. During our stay in Ireland we spoke with businessmen, and the various state agencies involved with giving grants to new businesses. We found many subtle differences between the economic structures of the two countries, but the more important findings were the non-economic, (or social), factors that play a much greater role in the entrepreneurial process.

Report No. 86A039I pages 86

IT CAN ALL BE YOURS

Student: Nancy M. Pimental
Advisor: L. E. Wimmergren

It Can All Be Yours is not another one of the hundred books out today that harps upon the "get rick quick" attitude, nor is it a report illustrating the step by step, fast and easy ways to make a buck. Instead, It Can All Be Yours is a guide to investing, steering college seniors, who might be uneducated or naive about the world of finance, in some economically stable direction. The graduating senior will quickly see the abstract become the real as he adapts the basic principles and ideals outlined in this thesis to his own lifestyle and economics. This paper serves as an introduction to investing for the reader, guiding him through the initial understandings and philosophies of finance. When finished reading this guide, the reader will see the way money is to invest money.

Report No. 87D294I pages 85

MAKING MONEY ON WALL STREET

Advisor: Micholas P. Rusiniak
Advisor: R. R. Borden

This project develops a strategy for investing based on one's desire for money and fear of risk. The strategy is to gain a profit using a systematic, disciplined method based on quality of operating history and careful determination of value. By using stocks with a long proven track record their trends can be tracked and predicted using computer software. The software will determine the proce high's and low's of security. This historical analysis tells us when to buy and sell for profit.

Report 87D300I pages 85

PORTRAIT OF THE ELDERLY ATTITUDES AND CONCERNS

Students: Joan B. Hilly
Elizabeth M. Chutoransky
Advisor: R. I. Herrera

A survey was conducted to investigate the concerns and attitudes of the elderly, by the elderly and the younger generations. Differences in attitudes, general knowledge of financing, and symptoms of the aging process were compared throughout the different age brackets. Results from the survey were compared to documented results.

Report No. 87D339I pages 62

A CASE STUDY OF CORPORATE CULTURE: WANG LAB SCOTLAND

Students: Susan A. Morena
Danielle A. Koschmeder
Advisor: L. S. Graubard

This report is a study of organizational behavior at the Wang Laboratories plant in Stirling, Scotland. It includes an identification of the corporate culture and management style that exists, and the relationship of these factors to employee behavior. Identifying and defining the "ideal bureaucracy," the paper tries to highlight those areas where the Stirling operations deviate from this "ideal bureaucracy." Conclusions indicate that Wang's approach to managing this plant, although deviating somewhat from the ideal, is effective. The plant efficiently fulfills its role as a prime production center for Wang computers and related components in Scotland.

Report No. 87D245I pages 54

ENERGY FUTURE: A REPORT ON THE OIL MARKET

Student: Sandeep Palit
Advisor: V. Bluemel

This project analyzes the factors influencing the behavior of the oil market and its key players: Organization of Petroleum Exporting Countries (OPEC), the U.S. oil consumer, the U.S. Oil producer, non-OPEC producers. The project then suggests how the factors will affect future behavior of the oil market by 1990 and by 1995

Report No. 87D340I pages 56

FIBER OPTICS, TECHNOLOGY, AND COMPETITION

Students: David J. Winicki
Jeffrey S. Goldmeer
Advisor: T. H. Roddenbery

Fiber Optics is a relatively new form of communication; it is based on the transmission of light, instead of electricity. With the creation of this new technology, the economic community responded accordingly; new markets were quickly set up to handle an anticipated demand. This new technology arrived at the same time that the U.S. began to shift toward an information based society, in which efficient data transmission will become increasingly important.

Report No. 87D199I pages 71

IBM: ONE STEP IN FRONT OF ANTITRUST LEGISLATION

Students: Michael Daigle
Jam Paydavousi
Mark Masera
Advisor: T. H. Roddenbery

International Business Machines has expanded its manufacturing and marketing muscle throughout the communication and computer industries. Their performance has led them to become a target for antitrust action. This project investigates and analyzes several IBM antitrust cases, and draws conclusions concerning the courts interpretation of the antitrust laws, and their present and future effectiveness.

Report No. 87D157I pages 67

Social and Human Services

Faculty Coordinators:

Professor L. Schachterle
Professor J. van Alstyne

DIV 50

THE COMPUTER: A TOOL IN SPECIAL EDUCATION

Students: David S. Dutton
Mark R. St. Clair
Advisor: P. R. Christopher

This project examines the role of the computer in helping to meet the needs of handicapped students. Advances in hardware and in relevant software are noted. Several experts in the field of special education contribute their observations. Direct experience working with special needs students came under the guidance of Mr. Gregory Apkarian, special education teacher at Wawecus Road School in Worcester.

Report No. 86D239I pages 44

SCOUTING FOR THE HANDICAPPED

Student: Mark A. Osborne
Advisor: W. B. Miller

In this project, the relationship between technology and the handicapped is examined. Through direct contact with the handicapped and the completion of a specialized project the student is made aware of the problems of the handicapped. The project done in this case was the design and construction of an adjustable book stand software which will facilitate their learning.

Report No. 86D304I pages 58

SECURITY AND LIFE SAFETY

Students: Paul M. Cass
Ronald B. Jabara
Advisor: R. L. Custer

Security and life safety are two necessary functions required by all of today's building structures. Conflicting objectives lead to problems when each of these two systems are integrated throughout a building structure. The two systems have unique goals which vary according to implimentation in different occupancy types. Solution methods will be discussed for harmonious integration of the two systems for certain occupancies.

Report No. 86D251I pages 67

CONSENSUS AFFECTING THE DECISION TO BUILD

Student: David D. Latulippe
Advisor: G. F. Salazar

A case study analyzing the social and economic factors affecting the decision to build a public-oriented facility was performed on the proposed transforming of a hockey arena into a combined civic and health center. The qualitative assessment of these factors was based on interviews with representatives of the groups involved with the proposed project. Analysis of the interviews was performed within the framework of the consensus theory, which states that social change should occur once a consensus in support of the change is achieved. It has been concluded that this case supports this hypothesis.

Report No. 86D293I pages 92

PLAYGROUND DESIGN - TATNUCK SCHOOL, WORCESTER

Students: Kirstin K. Girdner
Lori J. Duncan
Drew Bertagna
James P. Barry, Jr.
Advisor: M. S. FitzPatrick

Research has shown that children's use of properly designed playground equipment can contribute greatly to their physical and mental development. At this time, the Tatnuck School in Worcester does not have enough in the way of playground facilities. It was the purpose of this project to design an appropriate "adventure" playground to meet the needs of the Tatnuck students and the community. The playground was designed to accommodate the varying ages, interests and skills of the student body. The Tatnuck Parents Association, who intend to construct such a facility, was given an oral presentation, a scaled model of the recommended playground, and a report including the design.

Report No. 86D239I Pages 156

ALCOHOL POLICY OF WORCESTER POLYTECHNIC INSTITUTE

Students: William M. Regan
Peter J. Ingle
Advisor: C. H. Koontz

The project concerns the alcohol policy at Worcester Polytechnic Institute. Information was gathered from numerous sources concerning the different topics of the alcohol policy. An analysis of the information resulted in proposals to the school.

Report No. 86D286I pages 85

STARTING A SMALL HOME-BASED TECHNICAL VENTURE

Student: Derrick P. Anderson
Advisor: J. A. Soetens

The project is intended as a guide for use by an engineer who sets out to start, on a small scale, his own business assembling electronic boards for computer equipment. The materials were assembled from information received in contacts with banks, insurance agencies, magazine advertising departments, potential competitors, and from information published by the Internal Revenue Service and the Small Business Administration. The result is a comprehensive "business plan" for use as a guideline by budding entrepreneurial engineers.

Report No. 86D232I pages 52

MATH ANXIETY

Student: Michele Lucier
Advisor: I. M. Young

This report is about math anxiety , which has been used to explain why some individuals do not perform well on mathenatical tasks despite their mathematical ability and why some discontinue their study of math beyond minimum high school requirements. Additional causes for this behavior are also cited. All of the causes pay particular attention to the differences between males and females. The results of a survey I administered to high school students are also discussed.

Report No. 86D320I pages 62

TEEN SUICIDE: PUBLICITY AND CONTAGION

Students: Robert Carroll
James F. Martin
Advisor: R. L. Smith

This project in the Worcester Juvenile Court program explores the notion of contagion as a factor in the suicide rate among teenagers and focuses on media publicity as a vehicle of contagion. From investigation of several cases in particular school systems, the authors are able to establish a strong correlation between these factors. Their results are outlined in a pamphlet warning school officials about the possible effects of publicity on contagion.

Report No. 86A002I pages 51

THE AMERICAN TAX REVOLT

Student: Aram Falsafi
Advisor: J. F. Wild

This project intended to compare the motives behind the voters' approval of Proposition 13 in California and Proposition 2-1/2 in Massachusetts. By studying and comparing the results of several independent exit polls carried out in the two states immediately following the referenda, many similarities and differences were discovered.

Report No. 86E005I pages 43

HOUSING RENOVATION FOR THE MOBILITY IMPAIRED

Student: Brian Banes Johnson
Advisor: N. A. Austin

My IQP consisted of designing a manual intended to aid a mobility impaired person make design decisions regarding alterations to their present residence to make it more accessible. Products available in the Worcester area are included, along with two case studies to show the use of this manual.

Report No. 86A006I pages 305

THE LOST IDEAL, A STUDENT'S VIEW OF THE WPI PLAN

Students: Gary A. Shepard
Peter A. Stiles
Advisor: R. R. Borden

The report includes first hand information on how "The Plan" positively affected some WPI students, and why many of the beneficial motivational aspects were lost with the Plan Changes of '84 through '86. Emphasis is on the Plan's intangible characteristics.

Report No. 86A049I pages 48

GOALS AND ASPIRATIONS OF COLLEGE "DROP OUTS"

Student: Paul C. Branche
Advisor: J. M. Wilkes

A small telephone interview study was conducted to explore the educational fate of WPI "dropouts." The study focus involved comparisons of the career goals, motivation, resources and family responsibilities of those who return and complete their degrees and those who do not. The author concludes that WPI has a sizable pool of interested, high potential ex-students whose return is prevented by family responsibilities. Those who may come back from this group have had massive family assistance, since WPI does not serve such students at all well.

Report No. 86A019I pages 62

NEWWA DATA BASE DEVELOPMENT

Students: Robert E. Maynard
Scott P. Pfeffer
Advisor: F. Hart

New England Water Works Association has a need to provide services to its members that will contribute to retaining existing membership and also to attract new members to the organization. This project fulfills one such service that will be valuable to the association and its members. It is the development of a statistical directory, a computerized information "bank", and other data (salary surveys, statistical surveys, etc.) pertinent to more effective management techniques within the water works organizations.

Report No. 86A042I pages 332

PARKING DEMAND STUDY AT SFGH

Students: Michael Green
Matthew MacDonald
John Oldham
Advisor: H. G. Vassallo

The project involved an in-depth analysis of the serious parking problems facing SFGH. The analysis, conducted at SFGH, consisted of determing the parking requirements of the hospital by collecting statistics on such characteristics as outpatient clinics, employee needs, and visitor requirements, and comparing these needs with the presently available parking spaces. Shortcomings in the existing parking systems were identified and recommendations for short and long term solutions were developed and presented to the hospital administration.

Report No. 86A034I pages 118

BOY SCOUTING FOR HANDICAPPED

Student: James F. Daly, III
Advisor: W. B. Miller

The Scouting for the Handicapped IQP addresses the learning habits of physically and mentally disabled children at the Mill Swan Elementary School in Worcester through the means of Boy and Girl Scouting. The project also includes the design and development of an adaptive cursor computer keyboard for quadriplegic children.

Report No. 86B017I pages 46

SCOUTING FOR HANDICAPPED

Student: Ross Beiler
Advisor: W. B. Miller

This paper is concerned with scouting for the handicapped which combines the concepts of scouting and technology to provide a program that enriches the lives of handicapped and special needs children. The author discusses his one and a half year commitment and concludes with the design and building of the Reaction Timer, a beneficial device for improving motor skills.

Report No. 86B039I pages 50

SCOUTING FOR HANDICAPPED

Student: Michael Rousseau
Advisor: W. B. Miller

This project report discusses the goals and format of the IQP Scouting for the Handicapped, as well as the design of a computer word game to aid handicapped students.

Report No. 86B072I pages 63

DEVELOPMENT OF AN INFORMATIONAL BOOKLET FOR DRUNK DRIVING

Students: Lee Lopes
Thomas E. Murphys
Advisor: R. D. Desrosiers

The objective of this report is to develop an informational pamphlet on a major problem in today's society: drunk driving. This project examines the effects of alcohol on the human body. The social and cultural attitudes of alcohol consumption is also reviewed. The Mass. Safe Roads Act of 1986 is discussed along with an analysis of the drunk driver. Strong drunk driving laws must be enforced all times in order to be effective.

Report No. 86B062I pages 150

DESIGN OF A RIFLE AND PISTOL RANGE AT MASSACHUSETTS CORRECTIONAL INSTITUTION, NORFOLK, MA

Students: Gregory S. Burns
Patrick W. Hopkins
Christopher McGinty
Advisor: R.R. Borden

In this IQP, suggestions are made for the design of a rifle and pistol shooting range on the grounds of Massachusetts Correctional Institution, Norfolk, MA. All aspects of a typical shooting range were researched. This information has been presented in an orderly fashion in our report and will be used as desired at Norfolk.

Report No. 86B041I pages 194

THE PREDICTION AND TREATMENT OF VIOLENT JUVENILES

Student: Michal E. Donelan
Advisor: R. L. Smith

This project examines the prediction and treatment of violence in juveniles. The science of psychiatry and the technology of statistical analysis is used to examine effectiveness rates in the prediction and treatment of violence. In addition to the final report the project produced a pamphlet for distribution to youth serving agencies concerned with the needs of violent youths.

Report No. 86D306I pages 81

SCOUTING FOR HANDICAPPED

Student: Scott Flaherty
Advisor: W. B. Miller

The experience of a Boy Scout Leader for a deaf troop for the time period of a year and a half is described in this report. An in-depth study of American Sign Language and Signed Exact English was conducted. No judgement of which language wes better was made, although much information was obtained.

Report No. 86D136I pages 31

SCOUTING FOR HANDICAPPED

Students: Paul Cunningham
Christopher Paul
Advisor: W. B. Miller

The purpose of this IQP was to teach and develop the skills of handicapped students through scouting. Major goals of the project consisted of developing a relationship with the students and participating in a reciprocal learning experience. An understanding of the educational process for handicapped students was to be developed as well as the limits of the handicapped in today's society. Another major goal was to develop a device that would aid in the handicapped students' educational and emotional development.

Report No. 87D153I pages 76

EXPERIMENTS IN ELECTRICITY FOR GIFTED CHILDREN

Students: John Veilleux
David Caiati
Alan Hold
Advisor: W. B. Miller

This IQP is the development of a manual used as a teaching aid for gifted students enrolled in an electrical science course. Research on identification and teaching techniques precluded the manual's development. The students in Mrs. Garniewicz's fourth grade P.E.A.K. program were used to test several of the exercises in the manual. Finally, the IQP concludes with comments about the tested exercises and the various student reactions.

Report No. 87D115I pages 75

COMPUTERIZED INFORMATION RETRIEVAL SYSTEM

Students: Diane M. Desrosiers
Jill A. Richardson
Advisor: L. Schachterle

The Company of Scientific Instrument Makers of London, England, recognized the need for a classification system for the historical material of the Company. The purposes of this project are 1) to devise and validate methodology to establish the records on a database and 2) to implement a computerized information retrieval system to be used in conjunction with the database. Schools Information Retrieval Program, a British library project, was the software package used to establish the database on the computer.

Report No. 87D165I pages 92

WEIGHT COACHING TECHNIQUES

Student: William J. Cotter
Advisor: M. M. Norcross

The first part of the project consisted of the coaching of the Doherty Memorial High School track team. Different coaching methods were explored. A brief discussion of discus and shot put technique was followed by a discussion of weight training for track and field athletes as developed by author.

Report No. 87D142I pages 41

SCOUTING FOR THE HANDICAPPED

Student: Gary A. Allen
Advisor: W. B. Miller

The observations and experiences of a Boy Scout Leader for a troop of physically handicapped students over the period of a year and a half are described. During this time, the need arose for a portable inclining desktop to be used by physically handicapped students. A desktop was engineered and constructed to fit the needs of a special education teacher at the Millswan Elementary School in Worcester. The design implemented and results of its classroom applications are examined.

Report No. 87D053I pages 57

BMET PHYSIOLOGY COURSE. RESPIRATORY SYSTEM

Student: Mark J. McGovern
Advisor: D. G. Gibson III

This project is a manual designed to teach the anatomy and physiology of the respiratory system to biomedical technicians. The manual is composed of five sections which detail the respiratory system and one section which describes the basic operation of respirators. There is a self-quiz after each section to check the technician's understanding of the material. Answers and explanations are provided at the end of the manual.

Report No. 87D029I pages 70

PREFRENCE EVALUATION IN THE WOOD FURNITURE MARKET

Student: Joseph W. Donze
Advisor: G. F. Salazar

The goal of this project is to aid consumers who are in the market to buy wood furniture understand and evaluate the structural quality of many styles of furniture. The project also sets forth a multiattribute objective function method for aiding the consumers in their furniture prefrence analysis

Report No. 87D170I pages 94

SCOUTING FOR THE HANDICAPPED

Student: Leo E. Guertin, III
Advisor: W. B. Miller

The purpose of this IQP project is to aid in the development of handicapped youth in the Worcester school system. This was realized through activities and learning situations based on the programs of the Boy Scouts of America and the Girl Scouts of America. Included is a discussion of a special program designed to acquaint severely handicapped children with society.

Report No. 87D210I pages 67

SCOUTING FOR THE HANDICAPPED

Students: Maryanne C. Lemaire
Advisor: W. B. Miller

The Scouting for the Handicapped Project provides a unique opportunity for engineering students to interact directly with a section of society. Through scouting sessions engineering students can help special-needs students from a local elementary school to improve their basic knowledge and skills. In this project, a mechanical device which is an educational tool is built that in one way or the other can benefit the scout, the troup, or the handicapped in general.

Report No. 87D254I pages 56

SCOUTING FOR THE HANDICAPPED

Student: Paul McCluskey
Advisor: W. B. Miller

This paper is the culmination of six terms of work with children at a special education school in Worcester, MA. These children were primarily from a Behavioral Disabilities (BD) classroom. They have a variety of emotional problems that affect their educational abilities, and these problems appear to make them prime candidates to become high school dropouts. This paper then discusses the nature of the dropout, possible, causes, and possible solutions.

Report No. 87D266I pages 40

SCOUTING FOR THE HANDICAPPED

Student: Robert W. Watts
Advisor: W. B. Miller

The Technology and Special Education IQP is a project which involves a group of students at WPI, teaching scouting (boy or girl) to handicapped children in Worcester area elementary schools. The IQP involves weekly visits with the children, and a project designed and built by the leaders which will benefit the children according to their handicaps.

Report No. 87D332I pages 40

SCOUTING FOR THE HANDICAPPED

Student: Benjamin Arnold
Advisor: W. B. Miller

The Boy Scouts of America Cub Scout program was adapted to allow handicapped youths to participate. Students acted as scout leaders to implement the adapted program. In addition, a project was constructed to aid physically handicapped children at Rehabilitation Programs, Inc. in Poughkeepsie, NY.

Report No. 87D064I pages 35

UNLOCKING THE DOOR TO SEXUAL EDUCATION

Students: Michael McCourt
Kevin A. Griswold
Robert R. Hindman
Advisor: W. A. B. Addison, Jr.

Most parents feel that sexual education should be left in the home. However, as evidenced by high rates of teenage pregnancy and the spread of social diseases, especially AIDS, the burden of this education cannot be solely left with the parents. The public school system would be the most effective medium to accomplish "prevention." Therefore we propose to produce a pamphlet containing information pertinent to the implementation of sexual education courses for use by the Worcester School Department.

Report No. 87D208I pages 52

THE FEASIBILITY OF A WPI DAY CARE FACILITY

Students: Christine O'Toole
Christina Waldorfer
Advisor: M. Davis

"The Feasibility of a WPI Day Care Facility," the topic of this IQP, established that the need for quality day care from infancy to pre-kindergarden ages is greatly in demand in the Worcester area. A unique program of care has been devised for a maximum of forty-three children at the on-campus site of Founders Hall.

Report No. 87C044I pages 133

AUTOMATION AND THE BRITISH LABOR FORCE

Student: Miguel Ferre
Advisor: A. Gerstenfeld

The introduction of automation in manufacturing companies has had a big impact in the workforce. This project is a study on what the government in Britain, as well as various organizations, are doing to accommodate this impact the best possible way. The study proved that in Britain many programs are being set up to prepare the workforce with the necessary skills involved with automation.

Report No. 87D182I pages 59

THE INFLUENCE OF CONTEMPORARY MUSIC ON AMERICAN YOUTH

Students: Brian K. Standley
Laurie MacLean
Robert J. Bennecchi
Advisor: L. Goodwin

This project involves investigative research on the influence of contemporary music upon the attitudes and actions of American teenagers. The material employed in this project includes an overview of the controversies between Rock and Roll and authority, as well as the psychological and physiological effects of music. Data are presented on the reactions of forty college students and twenty two high school students to selected popular songs.

Report No. 87D084I pages 145

COMPARISONS OF MAINSTREAM AND RESOURCE-ROOM STUDENTS CONCERNING EMPLOYMENT

Student: Julie D. Peck
Advisor: L. Schachterle

This report compares maintaining part-time jobs held by special-education and mainstream students in Worcester public schools. The report documents the methods and results obtained from a questionnaire distributed to both groups in local high schools. Various statistical differences in results are noted using SSPS-X analysis. Students in Resource Rooms are sometimes discriminated against in employment; this report shows why this practice is not justified in terms of performance records for these students.

Report No. 87D287I pages 66

KINEMATICS OF KARATE

Student: James S. Mochel
Advisor: T. Hammond

In order to clarify the differences between Uechi-Ryu Karate-Do and Shotokan Karate-Do, a kicking technique and a punching technique are analysed. A gridded videotape of the strikes is used to evaluate the velocities and accelerations of the techniques. The results include the validification of the traditional martial arts concept of aiming a punch at a point beyond the point of impact.

Report No. 87D272I pages 49

SCOUTING FOR THE HANDICAPPED

Student: Deborah A. Murphy
Advisor: W. B. Miller

The observations and experiences of a Girl Scout Leader for a deaf troop over the period of a year and a half are described. During this time, the need arose for a portable, inclining desktop to be used by physically handicapped students. A desktop was engineered and constructed to fit the needs of a special education teacher at the Millswan Elementary School in Worcester, Massachusetts. The design implemented and the results of its classroom applications are examined.

Report No. 87D034I pages 60

HOW TO RESTORE YOUR TRIUMPH TR6 AND KEEP IT ON THE ROAD

Student: R. Scott Phillips
Advisor: R. R. Borden

This project is a publishable (by author only) manual that shows how to restore a Triumph TR6 sportscar. Its content is somewhat informal; it gives information on buying a TR6, tools, equipment, procedures and routine maintenance. It strives to give information pertinent to restoring that is not in present shop manuals. However, it does not stand alone; it is designed to be used with a shop manual.

Report No. 87D273I pages 123

HYBRID TECHNOLOGISTS FOR OVERSEAS DEVELOPMENT

Student: Donald W. Abel, Jr.
Advisor: J. M. Wilkes

The objective of this project was to develop an educational program at WPI which would combine a technical education with a minor or second major in the social sciences and a program of area studies. The establishment of a working relationship between WPI and the Peace Corps through the projects program and other avenues was also actively pursued. This will serve to develop socially and technically aware graduates for service in the international arena, especially for service in the Peace Corps.

Report No. 87D045I pages 41

MULTI-TRACK RECORDING STUDIO

Students: Michael J. Palmer
Joseph J. Pisano
Robert J. Provost, Jr.
Advisor: L. J. Curran

This project deals with the establishment of a recording recital hall for the WPI Community. Included are examples of other installations throughout the northeast.

Report No. 87D341I pages 183

PROFESSIONAL ETHICS

Student: Mary Kendrick
Advisor: S. Vick

The purpose of this project is twofold. The first part theoretically examines the motivations behind career decisions. The second part tests the theories formed in the first part through a social science survey administered to WPI students and alumni. The survey proves that both WPI students and alumni, in the areas of science and engineering, exhibit practical work ethics.

Report No. 87D240I pages 271

SYSTEMS ANALYSIS/EVALUATION OF PERC OF SAN FRANCISCO GENERAL HOSPITAL

Students: Denise Boteino
Elaine Gonsalves
Advisor: H. G. Vassallo

Our project was to act as process consultants for the Patient Education Resource Center for San Francisco General Hospital. We implemented a set of activites which helped the staff of PERC to perceive, understand and act upon the process of events which occur in their organization. We used a system approach in the evaluation; i.e., scientific methods and mathematical models to develop solutions.

Report No. 87D097I pages 216

Educational Theory and Curricular Development

Faculty Coordinators:

Professor L. Goodwin
Professor M. Humi
Professor T. Keil

DIV 51

READING, WRITING, ARITHMETIC ... AND COMPUTERS?

Students: Mark A. Hampson
Thomas C. Murphy
Advisors: T. H. Keil

In order for a definition of computer literacy to be considered complete, it must satisfy the requirements of clarity, situation independence, flexability in application, and ease of measurement. This report proposes such a definition and a means of applying this definition to an educational environment.

Report No. 87C031I pages 51

THE FEASIBILITY OF PC CADD IN INDUSTRY

Students: Kevin T. Manley
Timothy G. Simmone
Douglas R. Wennberg
Advisor: G. Y. Jumper

The feasibility of the implementation of Computer Aided Design into industry using personal computers (PC CADD) is discussed. An evaluation of the current PC CADD systems and an assessment of industry needs showed PC CADD to be a cost-effective powerful design tool which can, and has been, successfully integrated into the design departments of many companies. However, there are some applications where the presently limiting power of the person computer cannot meet the demands of industry.

Report No. 87C005I pages 183

COMPUTER ASSISTED INSTRUCTION FOR ELEMENTARY PHYSICS

Student: William J. Eikleberry
Advisor: T. H. Keil

This project concerns a computer program to graphically demonstrate simple harmonic motion, a brief analysis of program style for effective implementation into an elementary physics course in oscillations and waves.

Report No. 87C024I pages 73

ABC'S IN LOGO

Students: Thomas Tashjian
Joan Hamel
Jay Amar Kapur
Advisor: K. A. Lemone

Seymour Papert's Mindstorms discusses using computers as a "carrier of cultural 'germs' or 'seeds' whose intellectual products will not need technological support once they take root in an actively growing mind." Our project's main objective is to plant that seed so that computers won't become, as Papert says, "creatures of the 'engineers' alone", but rather that no one will feel uncomfortable with computers.

Report No. 87C030I pages 226

EDUCATING TEENAGERS ON ALCOHOL AND DRIVING

Students: Leslie J. Berchtold
Nancy Kokosa
Christine Kracunas
Advisor: R. L. Smith

This project in the Worcester Juvenile Court Program is concerned with translating scientific material on the biological and physiological effects of alcohol on driving ability into educational information for teenagers. From a survey conducted in two high schools, the authors developed a video focused on the problem of judgment and self-assessment when drinking and driving. The video is available for community use.

Report No. 86D241I pages 80

A BEGINNER'S GUIDE TO HOLOGRAPHY

Student: James S. Spitaels
Advisor: H. W. Hilsinger

This IQP is a guide to the design, construction and operation of a simple holography laboratory. Through research and experimentation, it was determined that quality holograms can be made using common equipment and simple procedures. This was demonstrated by constructing a permanent laboratory for use in future advance-placement physics courses at Doherty Memorial High School, Worcester.

Report No. 86D322I pages 52

HIGH SCHOOL CALCULUS

Students: Michael Skowron
Michael Skorlo
Ari Chaney
Advisor: V. F. Connolly

This project introduced high school students to the rudimentary principles of calculus, as well as interested them in pursuing technical education.

Report No. 86D254I pages 83

PREDICTING SAT SCORES

Students: Donald Walker
David DeLacey
Advisor: J. D. Petrucelli

An inquiry was conducted to determine the relationship between SAT scores, PSAT scores, and grades earned in high school courses. Transcripts from Shrewsbury High School were statistically analyzed. The results of this analysis suggest that 1) SAT scores are best predicted by PSAT scores and previous SAT scores, 2) math scores are more difficult to predict accurately.

Report No. 86D264I pages 84

TECHNOLOGY OF SPECIAL EDUCATION IN RESOURCE ROOM

Student: James B. Berry
Advisor: L. E. Schachterle

This project explores the technology of special education. More specifically, it involves the study of behavior modification techniques and the handicaps of the children in the resource room at the Tatnuck Elementary School. Both research and classroom observation were utilized to formulate recommendations for future interactive qualifying projects in the resource room.

Report No. 86D242I pages 30

UPGRADING STP

Student: Warren Blaisdell
Advisor: J. D. Petrucelli

The STP statistical package is one of several available for use at WPI. This package was very useful, but was becoming outdated. For this reason, several more recent statistical developments were added, dealing with normal probability plots, t-tests, and various types of regression and regression diagnostics.

Report No. 86D243I pages 149

THE LIGHTBOX: AN AID TO IMPROVE HANDWRITING

Students: Cindy Perkins
Stephen Montibello
James Bennett
Advisor: P. S. Onuf

This project addresses poor handwriting skills of seventh and eighth grade students in special needs courses. Handwriting samples of a select group of students working with the lightbox were analyzed and compared to establish its effectiveness in dealing with letter formation, sizing, spacing, slant, and alignment problems.

Report No. 86D302I pages 112

CHEMICAL ENGINEERING IN THE 21ST CENTURY

Student: Andrew Skinner
Advisor: A. G. Dixon

A study of the history and present status of chemical engineering and the chemical engineering industry using literature and a survey was conducted. From this study, the future of the chemical engineering industry was estimated. The chemical engineering curriculum of Worcester Polytechnic Institute was evaluated. A modified chemical engineering curriculum that may better prepare chemical engineering students for the future was proposed.

Report No. 86D310I pages 64

LECTURE DEMONSTRATIONS AS A METHOD FOR TEACHING

Student: Harold Vincent, II
Advisor: H. W. Hilsinger

Various lecture demonstrations conducted for high school physics students are summarized. Problems assigned to the students, involving the principles introduced in the demonstrations, are analyzed to determine if the demonstrations were effective teaching tools.

Report No. 86D312I pages 29

A MODEL FOR GRAMMAR ACQUISITION

Student: Richard Kaminsky
Advisor: L. A. Becker

A simple model of language acquisition is presented which incrementally generates a context-free grammar from example sentences. The method by which the model learns may give insight into the way people learn language. A Common LISP implementation is used to demonstrate the model.

Report No. 86D289I pages 63

INTEL SYSTEM CONSTRUCTION

Students: John FitzGerald
Mark Mckeown
Advisor: G. F. Salazar

A grant from the Intel Company has supplied the Civil Engineering Department at WPI with an Intel 86/380 Microcomputer System intended to support a discrete event simulation program on tunnel construction. This project develops a system environment to support this simulation program as well as other programs written in Fortran. This was accomplished by following the instructions in the Intel supplied manuals and through interaction with the engineers at the Intel Company.

Report No. 86D273I pages 99

LOGO FOR LITTLE LEARNERS

Students: Deborah N. Matyi
Lisa S. Yeito
Advisor: K. A. Lemone

The purpose of this project is to test the theories of Seymour Papert described in his book, MINDSTORMS: Children, Computers and Powerful Ideas. In order to research this goal we spent seven weeks at the Elm Park Community School teaching six second and third grade children the aspects of a programming language SNAKE. SNAKE is similar to the language LOGO described by Papert. Included in this project are analyses of ideas presented in this project and children's responses to the teaching sessions. We have also made recommendations for future projects.

Report No. 86D297I pages 109

TEACHING PASCAL

Students: Eric E. Breisacher
John P. Drazek
Leela Keshavan
Advisor: P. F. Creegan, Jr.

A computer course emphasizing the Pascal programming language was taught to students at St. Peter Marian High School An exhaustive series of handouts, transparancies and example programs were developed for use in the course. Investigations into the problems of computer education in general were also carried out simultaneously.

Report No. 86D245I pages 103

IONIZATION AND ITS NATURAL MANIFESTATIONS

Students: John Hynes
James Myren
John Siegenbaler
Advisors: J. P. Hanlan
V. Bluemel

The goal of this project was to create a permanent exhibit for the Worcester Science Center explaining the process of ionization. By employing a device that generates a high electric potential, the exhibit demonstrates ionization of helium, neon, and argon. The potential produces an electric discharge inside the glass spheres thereby exciting the gas molecules. Each of the excited gasses emits light with a characteristic spectral distribution; they each glow a distinctive color. Interpretive text explains ionization and relates it to such naturally occurring manifestations as the northern lights.

Report No. 86D284I pages 40

VAXDRAW

Student: Guido K. Jouret
Advisor: S. Alpert

VaxDraw represents an effort to utilize state-of-the art computing in the process of education. The ability to present technical material in a graphical form has previously been hampered by both turn-around time and artistic ability. This project surveyed users, developed software, prepared user manuals, conducted usage trials and generated a video tape for use of this interactive tool.

Report No. 86D256I pages 60

HIGH SCHOOL CHEMISTRY

Student: Charles C. Cotter, Jr.
Advisor: R. E. Wagner

This study was completed in a twenty week period from January, 1986 to May, 1985 at the Bishop Feehan High School. It contains a detailed account of the objective, goals, teaching procedures and results of this project. Also included in the Appendices are the homework assignments, tests, quizzes and experiments. This study also takes a brief look at why there is now a teaching shortage.

Report No. 86D258I pages 122

GUIDELINES FOR JUNIOR HIGH SCHOOL SCIENCE TEXTS

Student: Mark A. Maguire
Leo Smith, III
Advisor: V. Bluemel
S. Jasperson

Junior High School science textbooks have come under recent critisms for emphasizing the content of science--words, definitions and facts--to the exclusion of the process of science--observation, posing and testing of hypotheses. We have studied the validity of such criticisms by examining several textbooks and selection procedures. We find that the criticisms are well founded; furthermore, we have developed a set of guidelines to be used in conjunction with current selection criteria in order that a balance between process and content may be restored.

Report No. 86D295I pages 80

CURRICULUM FOR TALENTED STUDENTS

Student: Patrick Connolly
Advisor: P. F. Creegan, Jr.

This project is intended to be an account of the experience of our group, in teaching lower level physics to fifth grade students. We taught at Chocksett Elementary School in Sterling, MA. This paper will include our advice as to whether or not physics should be taught at this level.

Report No. 86D316I pages 32

COMPUTER EDUCATION

Student: John R. Bastien
Advisor: M. Humi

The students in this project designed and taught a course in "Introductory Basic" to a class of high school students. As a result they achieved an appreciation for the educational techniques and curriculum to be used in such a course.

Report No. 86D138I pages 108

LEARNING MODULES FOR WORCESTER EAST MIDDLE SCHOOL

Student: John R. Bryant
Advisor: P. S. Onuf

This project, prepared for YOU Inc., explores learning disabilities and the various types of alternative education available. It resolves around the use of learning modules to educate children in the resource room at Worcester East Middle School. The project focused on the use of three approaches, hands-on, active games, and audio-visual, to attack weaknesses with consonant blends and diphthongs and digraphs. Pre- and post- tests were used to analyze the results. Recommendations for improvement and future use were made.

Report No. 86D247I pages 72

TUTORIAL AT HOLY NAME HIGH SCHOOL

Student: Randy J. Schramm
Advisor: V. F. Connolly

The project that was undertaken was tutoring mathematics at Holy Name High School. Because of the complexity of mathematics, many of the concepts and ideas are hard to understand when they are presented in a classroom. Therefore, I used my background in mathematics and my personal beliefs on teaching to help students who needed it and at the same time gave an important service to the Holy Name High School community.

Report No. 86A047I pages 28

TEACHING PASCAL

Students: George M. McLane
Gregory R. Vail
Advisors: R. C. Scott

The goal of this IQP was to develop a program of computer science, incorporate it into the existing classroom environment, and offer possible suggestions for improvement of the current curriculum. Teaching aids, to be left for the use of future teachers were also developed. Course work consisted of a pair of Pascal classes, one beginning and one advanced, conducted for 45 minutes per day, 5 days per week. The classes were conducted from 1/28/86 through 5/9/86.

Report No. 86A007I pages 92

THE TEACHING OF PASCAL

Student: Stephen J. Sullivan
Advisor: R. C. Scott

This Interactive Qualifying Project took the existing class environment and continued a Computer Science curriculum established by the Computer Science Department of Worcester, Massachusetts. The high school students were taught the Pascal programming language. The course covered the same material covered in the introductory course offered at Worcester Polytechnic Institute.

Report No. 86A010I pages 37

TEACHING H.S. ELECTRONICS

Students: Peter Beale
Paul S. Musto
Advisor: Russell Krackhardt

The objectives of this project were to design and teach a course in basic electronics targeted at high school level students. Book selection and construction of class notes, tests, and labs were tasks performed in the opening of this project. This pilot course was successful in establishing Basic Electronics as part of the Killingly High School curriculum.

Report No. 86A016I pages 78

COMPUTER EDUCATION

Student: Anthony J. Marino
Advisor: M. Humi

The students in this project designed and taught a course in "Introductory Basic" and word processing to a class of high school students. As a result they achieved an appreciation for the educational techniques and curriculum to be used in such a course.

Report No. 86A041I pages 153

MINDSTORMS - 7

Students: Raul H. Curbelo
Edward A. Valenti
Advisor: K. A. Lemone

This IQP introduced the concepts behind top-down problem solving to a group of elementary school students. This was accomplished by having the students learn how to break down large problems into smaller more manageable tasks. This project resulted in the students learning the very important ideas behind top-down problem solving, which will help these students to tackle problems in other areas.

Report No. 86A028I pages 111

COMPUTER ASSISTED INSTRUCTION FOR GERMAN GRAMMAR

Students: Ronald Avisa
Sharon Tauberfeld
Caleb A. Warner
Advisor: L. A. Becker

A program for Computer Assisted Instruction in German Grammar. Teaches student points of German grammar and tests student on knowledge. Program generates correct answer by following rules coded in program. Tells student where misconception is.

Report No. 86A014I pages 60

FUTURE OF PRIMARY EDUCATION IN LESS DEVELOPED COUNTRIES

Students: Jeffrey S. Allen
Michelle L. Colwell
Deirdre M. Tymann
Advisors: R. Long
L. E. Wimmergren

This report, prepared for the U.S. Agency for International Development, researches the present state and predicts future needs of primary education systems of 6 less-developed countries: Botswana, Burundi, Kenya, Somalia, and the Yemen Arab Republic. Using population, economic, and educational data, we project the increases in students, teachers, and schools needed to reach universal primary education or to maintain current enrollment ratios for each country. We determine the ability of each country to attain each of these goals and recommend applications of educational technologies which may assist in improving their education systems.

Report No. 86A011I pages 165

EE CONCEPT MODULES FOR RLC CIRCUITS, USING TURBO

Students: Robert F. Dugan, Jr.
Ronald W. Szeto
Advisor: J. S. Demetry

As with many technical disciplines, there are certain basic concepts in electrical engineering that are difficult for the student to grasp. This IQP provides graphics oriented "sandbox" tutoring modules along with a helpful user's guide that target some of these concepts. The powerful high resolution graphics of the AT&T 6300 Personal Computer, coupled with Turbo and Turbo Graphics Toolbox software were used to examine Series and Parallel RLC Circuit Response, Sinusoids, Phasor Addition and Subtraction, and Phasor Rotation.

Report No. 86B007I pages 150

WPI VS KMCE MAJOR ASPECTS OF THE CE EDUCATION

Student: Luiza Petrovska
Advisor: C. H. Koontz

The main idea of this project is to suggest ways of improving the civil engineering education at WPI through comparison and contrast of major aspects of the civil engineering education at WPI, USA vs. K.M.C.E., Europe. The descriptive passeges of the report are enlightened with numerous illustrations taken during the Spring of 1986 at WPI and during a visit to Yugoslavia in the summer of 1986.

Report No. 86A045I pages 40

STUDY OF UNDERGRADUATE MANUFACTURING ENGINEERING

Students: Joan A. Argarin
Gregory S. Duplessie
Robin A. Raymond
Advisor: R. Long
L. E. Wimmergren

This report, prepared for the Manufacturing Studies board of the National Research Council, addresses the challenge in promoting manufacturing among undergraduate engineers. There will be a strong need for engineers trained in the new processes to assist in the transformation to the active U.S. manufacturing sector. This need cannot be fulfilled without the participation of industry, academia, and public policy-makers. These institutions must act collectively to emphasize the need for manufacturing engineers and make the opportunities visible, appealing, and accessible to engineering undergraduates as well as high school students.

Report No. 86A013I pages 89

TEACHING OF HIGH SCHOOL CHEMISTRY AND PHYSICAL SCIENCE

Student: Michael J. Fronczak
Advisor: R. E. Wagner

This study represents observations and analysis of teaching style and method at the conclusion of a ten week teaching period for improving and comparing teaching techniques. The teaching project consisted of three separate classes over the ten week period. This report includes a description of the project, the goals of the project, the teaching process for each of the three classes, and the results of the project. Finally, improvements upon the science department and the curriculum are cited and suggested.

Report No. 86A031I pages 111

DESIGN/TEACHING HIGH SCHOOL CALCULUS COURSE

Students: Michael J. Iannacci
William J. Iannacci, III
Advisor: B. C. McQuarrie

The students designed and taught an evening calculus course at Malden Catholic High School. The preparation was done with extraordinary care and several new approaches and techniques were used in teaching the course.

Report No. 86A036I pages 242

SCIENCE FAIR PROJECTS IN AN ELEMENTARY SCHOOL

Students: Patrick E. Barrett
John T. Vaughey
Advisor: R. E. Wagner

In this project gifted fourth graders at the Chocksett Elementary School in Sterling, MA participated in a science class that was based on class projects, lecture demonstrations, in-class experiments, and a final individual science fair project. The ten students designed and built their own final projects applying concepts and techniques they had learned in the classroom. The ultimate goal of the project was to give the students a sense of accomplishment while at the same time giving them the opportunity to answer questions they had about science.

Report No. 86B012I pages 91

AN APPRENTICESHIP IN HIGH SCHOOL TEACHING

Student: Paul F. Skowronski
Advisor: R. E. Wagner

A teaching apprenticeship in advanced placement chemistry was undertaken at Saint John's High School in Shrewsbury, MA to gain experience in the field of education. Six students were taught using a college preparatory curriculum. In addition to the chemical principles and theory applied in the curriculum, supplemental laboratory work and demonstrations were performed. These promoted a better understanding of the subject and a broad view of a general chemistry sequence that one might encounter at an undergraduate university level.

Report No. 86B033I pages 69

EVALUATION OF THE SPOTLIGHT PROGRAM

Student: Ginger Robbins
Advisor: L. Schachterle

This is an evaluation of the computer analysis section of the Spotlight Program of Worcester. The Spotlight Program is aimed at teaching seventh and eighth graders to extend and apply what they have been taught in school. This evaluation will be used in order to better the program in the future.

Report No. 86A053I pages 78

BRITISH ELECTRICAL ENGINEERING EDUCATION: A COMPARSION WITH WPI

Students: Richard P. Gazda, Jr.
Robert J. Mauceri, Jr.
Advisor: P. F. Green

This project is an examination of the British University system's approach to an Electrical Engineering education. The project is comprised of detailed descriptions of Electrical Engineering programs at eight British Universities and a comparison of these programs to the degree course at WPI.

Report No. 86B056I pages 189

TEACHING HIGH SCHOOL ORGANIC CHEMISTRY

Student: Charles H. Champagne
Advisor: R. E. Wagner

Project entailed the instruction of an advanced science course at Kingswood Regional High School in Wolfeboro, NH. Over a twelve week period the students were instructed in the area of organic chemistry, at the college preparatory level. An extensive curriculum was developed for this course and left at the school for use by future instructors.

Report No. 86B045I pages 97

THE COST BENEFIT OF COOPERATIVE EDUCATION: A CASE STUDY

Student: Marc S. Salzman
Advisor: T. H. Keil

"The Cost Benefit of Cooperative Education, a Case Study," is an in-depth look at the Cooperative Education Program at General Electric, Wilmington, MA over a period of about five years. The costs incurred, and the benefits received were analyzed and compared to the costs and benefits of entry-level professionals. The result of the study took the form of a generalized cost model for any company as well as a cost-benefit analysis for GE Wilmington. The cost benefit analysis showed that there was a net dollar benefit for each coop hired as an alternative to an entry-level professional for a similar job.

Report No. 86B081I pages 79

A BEGINNER'S GUIDE TO HOLOGRAPHY

Student: Julie McKeon
Advisor: H. W. Hilsinger

This IQP is a guide to the design, construction and operation of a simple holography laboratory. Through research and experimentation, it was determined that quality holograms can be made using common equipment and simple procedures. This was demonstrated by constructing a permanent laboratory for use in future advance-placement physics courses at the Doherty Memorial High School, Worcester, MA.

Report No. 86D322I pages 43

WAR AND PEACE: THE WPI PLAN

Students: Stephen M. Gale
Bryan J. Sheppeck
Gregory T. Woods
Advisors: J. F. Zeugner
V. Bluemel

Since its acceptance, the WPI Plan has undergone constant evaluation and change, which has drastically altered its complexion. This IQP is an investigation of the evoluation of WPI's academic policy with specific focus on the motivating factors behind the alterations that have occurred between 1970 and 1986. The purpose being: (1) to provide a reasonably objective assessment of how the school's academic program reached its present state, and (2) to provide useful insight into possible future problems.

Report No. 87C055I pages 149

SCOUTING FOR THE HANDICAPPED

Student: Joseph P. Cauffiel
Advisor: W. B. Miller

This project represents an overview of the legal and scientific option of the validity in using IQP tests to place students in Educale Mentally Retarded classes. The legal aspects of IQ tests, centers around its constitutionality and its apparent discriminatory effects on black children. The scientific opinion focusses on the IQ test's credibility in assessing intellectual development and its consistency across ethnic boundaries. Additionally, this project entailed working with handicapped students through the Scouting program.

Report No. 87D123I pages 50

PHYSICS PROGRAM

Student: Kurt W. Schletter
Advisor: T. H. Keil

The Physics Diasnostics test is a tool meant to assess the basic knowledge level of students taking the first course in physics. This is a report of the results of this test administered at Worcester Polytechnic Institute as well as a comparison between the results at WPI and at Arizona State University, the originator of this test.

Report No. 87D037I pages 51

SOUND AND VIBRATIONS

Students: Mark Siciliano
David Cubanski
Advisor: R. Long

This product of the project is a durable, interactive sound exhibit for the New England Science Center, a science-oriented children's museum. The intent of the exhibit is to explain three basic concepts of sound: that sound is caused by vibrations, that the amplitude of the vibration is related to the sound's volume, and that the frequency of vibration is related to the sound's pitch. An electronic oscilloscope, a mechanical oscilloscope, and several sources of sound are used to convey these concepts.

Report No. 87D238I pages 35

A COMPUTER AIDED INSTRUCTION SYSTEM

Students: Joseph Rzepiegewski
William E. Fusaro
Bradley Wherry
Advisor: A. F. Chalabi

Computer Aided Instruction is a project which brings the ongoing growth of microcomputers into the field of engineering education. Four programs covering basic principles of Civil Engineering (CE) and Management Information Science (MIS) has been developed. While these programs demonstrate principles of CE and MIS they are also of service through the inherent instructional abilities. The microcomputer versions are developed with the intent to increase heir effectiveness as self-learning tools for students working in the CE and MIS fields.

Report No. 87D192I pages 192

ACADEMIC AND SOCIAL ENVIRONMENTS AT WPI

Students: Alan C. Brightman
Scott Bishop
Michael N. Hartnett
John Waples
Advisor: L. Goodwin

This project is a study of the interrelation of academic performance, alcohol consumption, and social interaction of WPI undergraduates. Responses to a questionnaire were gathered and analyzed through SPSSX, a computerized statistical analysis program. The results obtained pave the way for additional projects involved with improving the social and academic life at WPI.

Report No. 87D327I pages 70

TEACHING METHODS FOR MISCONCEPTIONS IN PHYSICS

Students: Stephen Hall
Dnnis LaFosse
Advisor: R. Long

Misconception areas in physics have plagued students and teachers. Two misconception areas, the position-velocity-acceleration misconception are described and teaching resources are developed for them. A general guideline for teaching methods is presented, based largely on Piaget's theory of cognitive development and a phenomenological approach as suggested by Arons. The teaching resources developed include lecture notes and outlines for conference presentations for both misconceptions, a graphing handout, and several sets of problems with answers.

Report No. 87D235I pages 97

DESIGN-INSTRUCTION OF HIGH SCHOOL CALCULUS COURSE

Students: John Yered
Douglas Willard
Eric Pauer
Advisor: B. C. McQuarrie

This IQP involved designing and teaching a Calculus course at Burncoat Senior High School, Worcester, MA. Classes were held after school fourtimes each week during Term C87. The topics covered include limits, the derivative, and the integral. The course was held in an informal atmosphere using a seminar style format. Demonstrations and applications of Calculus were employed to illustrate its usefulness to a variety of fields.

Report No. 87D285I pages 49

OPEN VS CLOSED CLASSROOMS A COMPARISON OF EDUCATION

Students: David P. Picarillo
Robert T. Schruender
Diane V. Fyrer
Advisor: L. Goodwin

This paper is a study of the impact of different classroom environments on education in three high schools. The environments are: open, semi-open, and closed classrooms. Data were gathered at each high school, including six classroom observations, personal teacher interviews, and a survey form completed by all teachers. It was concluded that open concept classrooms experience more problems with noise and distractions than the traditional classrooms.

Report No. 87D234I pages 206

SCIENCE EDUCATION

Students: Vinay Kundaje
Mike Basmajian
Advisor: M. Humi

In this project the students designed and taught a course in Science - Experiments for fourth graders. It was assessed the course had a stimulating and long lasting effect on the participating students.

Report No. 87D079I pages 178

LASERS, LIGHT: REFLECTION AND EDUCATIONAL MANUAL

Students: Ronald P. Wen
Thomas J. Schihly
Advisor: R. Long

An educational manual was created for use by the New England Science Center. The manual presents an exhibition on lasers, light, reflection and refraction. The first part of the report contains a chronology of the process and steps needed to create the manual. The second part of the report is the manual itself, which includes all the necessary information to recreate the show. Testing of the exhibition was carried out at the Yeshiva Day School for practical experience in front of young students.

Report No. 87D322I pages 82

PROTOTYPE INTERACTIVE VIDEODISC INSTRUCTION

Students: Philip A. Buttacavoli
Barbara J. Grimm
Daniel O. Olsen
Karen E. Valentine
Advisor: J. S. Demetry

The goal of this IQP was to use the technology of Interactive Videodiscs to create an instructional package simulating a chemistry lab performed at WPI. This task proved to be one which involved many different kinds of work, such as research, project planning, resource coordination, evaluation, and documentation. The goal was achieved; an instructional package entitled Qualitative Inorganic Analysis was developed and briefly evaluated.

Report No. 87D236I pages 69

TEACHING SCIENCE IN THE ELEMENTARY SCHOOL

Students: James H. Graffam, Jr.
Michael S. Brotherton
Advisor: S. N. Jasperson

The purpose of this project was to give a group of elementary school students hands-on experience with selected science topics to supplement textbook instruction. We developed several laboratories and demonstrations grouped into units which covered five topics of science in the curriculum. Teacher's guides as well as student guides were developed so that the teacher could conduct the units in the same fashion in subsequent years. A critique of accomplishments in each of our classroom sessions is included.

Report No. 87D323I pages 97

SCIENCE EDUCATION CURRICULUM DEVELOPMENT

Students: Gregory Mayo
Thomas A. McCormick
Francis J. Labuski
Advisor: J. M. Wilkes

A 2 week 8th Grade Science Course Module on "Energy" was created as part of an experiment on the use of S.T.S. materials as a medium for Teaching Science to enhance technology literacy. Two classes were involved. Both used the same text chapter, but only one experienced the integrated learning module. The experimental class evaluation indicated greater class participation, factual understanding and development of grounded opinion's about nuclear power. There was no gain in retention of factual detail (over a 2 week break).

Report No. 87D019I pages 91

ENRICHMENT TUTORIAL PROGRAM IN GEOMETRY

Students: Maikel S. Haddad
Carlene J. Hannigan
Advisor: I. Bar-On

The purpose of this project is to prepare an Enrichment Tutorial Program in Geometry for the Solomon Schechter Day School. Using Piaget's Theory on child development and mathematical activities, we will develop a modular program using manipulative to expand the fifth and sixth grades' geometric concepts and mathematical reasoning. At the end of the program other students will be able to use the activities on their own to expand their knowledge of geometry.

Report No. 87D213I pages 73

COMPUTER EDUCATION

Student: Linda Chambre
Advisor: M. Humi

In this project Ms. Linda A. Chambre designed and taught a course in basic programming, word processing and spread sheet analysis. The course was used also to apply and examine various trends and theories in computer education.

Report No. 87D126I pages 145

INTERACTIVE PROBLEM AND STATISTICS TUTORIALS

Student: Alphonse J. San Clemente
Advisor: M. Davis

An interactive computer based tutorial for probability and statistics, originally written by Andy Ferreira and Mike Perrone under the supervision of Dr. Joseph Petruccelli. Installation of variable direction paging and revision of the module on the Central Limit Theorem are the major contributions to the tutorial.

Report No. 87B074I pages 129

THE DESIGN OF DISCOVERY-BASED LEARNING AIDS

Student: Gary Goodell
Advisor: J. A. Weiss

Techniques for designing computer-based learning materials were studied by developing three programmed lessons. The lessons explore methods of guiding students toward personal discovery of concepts. The first Pascal program allows student exploration of motion governed by two algebraic functions. The second program introduces the arrow representation of vectors. Third is a guided simulation of motion along a trajectory. Software was written to demonstrate courseware development techniques but, with some modification, would be suitable for use in introductory physics courses.

Report No. 87D201I pages 88

ORDERING INFORMATION FOR COMPLETE PROJECT REPORTS

The complete project reports of the Interactive Qualifying Projects listed in the abstract section of this publication are available at cost from the Division of Interdisciplinary Affairs, Worcester Polytechnic Institute, Worcester, Massachusetts. Specific inquiries about the WPI Projects Program are invited and welcomed. Such inquiries should be addressed to Professor Lance Schachterle, Chairman of the Division of Interdisciplinary Affairs at WPI.

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